GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
9769.000.000

October 2, 2017

Mr. Mike O'Hara
North Waterfront Cove, LLC
c/o Tim Lewis Communities
3300 Douglas Boulevard, Suite 450
Roseville, CA 95661

Subject: Encinal Terminals
Alameda, California

SLOPE STABILITY ANALYSIS WITH GROUND IMPROVEMENT

Dear Mr. O'Hara:

We prepared this supplemental evaluation of the shoreline seismic slope stability of the Encinal Terminals property in Alameda, California. We performed the analyses summarized in this letter in order to further evaluate shoreline stability and refine the ground improvement concept for planning purposes. This evaluation is intended to supplement our geotechnical report for the planned site development. As discussed in that report, we identified a potential for excessive shoreline displacement during a design-level earthquake.

GEOMETRY AND IDEALIZED SOIL PROFILES

Along the western shoreline, under the existing wharf, four cross sections were prepared; three cross sections are perpendicular to the wharf, and one is longitudinal to the wharf. Additionally, two sections were prepared on the northern shoreline, and two were prepared on the eastern shoreline. Figure 2 depicts the locations of the sections, and Figure 5 shows the sections. The slope of the mud line in these cross sections was determined using plans depicting the dredging of the area prior to the construction of the C2 wharf structure in the 1960s. In all of these cross sections, the mud line was determined based on 2013 bathymetry provided to us by Carlson, Barbee and Gibson (CBG), the project Civil Engineer.

The subsurface exploration and geotechnical conditions are presented in the geotechnical exploration report (ENGEO, 2017). Figure 2 presents the mapped historic shoreline. The strength profile of the subsurface soils are deemed to be different on each side of the historic shoreline, particularly where dredging would have occurred.

SEISMIC DESIGN CRITERIA

Based on the site geology and type of structure being analyzed, it is our opinion that the seismic performance of the shoreline and the effects on the existing wharf, and planned structures, due to slope movement, be designed for the Design Earthquake (DE) (defined as 2/3 of the MCE_R). To develop the site DE, a site-specific site response analysis was performed.

Since the depth of the bedrock at the site is over 500 feet, the base of the site response was evaluated at the interface for a Site Class D stiff soil site. This seismic hazard was evaluated by performing a site-specific hazard analysis.

The site-specific spectral response for a Site Class D, was evaluated in accordance with the methodologies described in Chapter 21 of ASCE 7-10. The following approach was used to develop a site-specific DE spectra for a Site Class D:

- A probabilistic seismic hazard analysis (PSHA) to develop a risk-targeted maximum rotated response spectrum corresponding to a 2-percent probability of exceedance in 50 years (2,500-year return period).
- A site-specific deterministic analysis (DSHA) to develop 84th-percentile maximum rotated geometric mean response spectrum considering a moment magnitude 7.3 earthquake occurring on the Hayward fault a moment magnitude 8.1 earthquake occurring on San Andreas fault.
- Comparison of the DSHA and the Deterministic Lower Limit in accordance with Section 21.2.2 of ASCE 7-10.
- Comparison of the PSHA and the DSHA spectra to obtain the site-specific MCE_R ground motions for the site.
- Development of DE response spectrum as 2/3 of MCE_R and comparison with 80 percent of the response spectrum determined in accordance with Section 11.4.7 of ASCE 7-10.

Probabilistic Seismic Hazard Analysis

Probabilistic Model

EZFRISK (Risk Engineering, 2015) was used to develop a probabilistic seismic hazard analysis (PSHA) for the project site for a return period of 2,500 years. EZFRISK calculates seismic hazard using the standard methodology for hazard analysis. The seismic-hazard calculations can be represented by the following equation, which is an application of the total-probability theorem.

$$H(a) = \sum_i v_i \iint P[A > a|m,r]\, f_{Mi}(\mathrm{m})\, f_{Ri|Mi}(\mathrm{r,m})\, dr\, dm$$

In this equation, the hazard H(a) is the annual frequency of earthquakes that produce a ground motion amplitude A higher than the selected amplitude a. Amplitude A may represent peak ground acceleration, velocity or displacement, or it may represent spectral pseudo-acceleration for a given frequency. The summation in the equation shown extends over all sources, i.e. over all faults and areas, vi is the annual rate of earthquakes (with magnitude higher than some threshold Mi) in source I, and fMi (m) and fRi|Mi (r,m) are the probability density functions on magnitude and distance, respectively. P[A > a|m, r] is the probability that an earthquake of magnitude m at distance r produces a ground-motion amplitude A at the site that is greater than a.

Seismic sources may be either faults or area sources; the specification of source geometries and the calculation of fRi|Mi, are performed differently for these two types of sources.

Fault Database and Model

The USGS 2008 National Seismic Hazard Map was selected as the seismic model. The following table, extracted from EZFRISK, shows the seismic sources used in the PSHA analysis:

TABLE 1: Seismic Sources

SOURCE	CLOSEST DISTANCE (km)	MOMENT MAGNITUDE (M_W)	FAULT MECHANISM	SITE LIES
Bartlett Springs	130	7.3	Strike Slip	S
Calaveras	22.38	7.025	Strike Slip	W
California Gridded	0.00	7	SS|R	Above
California Gridded Deep	36.08	7.2	Intraslab	S
Collayomi	116.96	6.7	Strike Slip	S
Great Valley 1	167.48	6.8	Reverse	S
Great Valley 10	168.58	6.501	Reverse	NW
Great Valley 11	190.49	6.6	Reverse	NW
Great Valley 2	145.68	6.501	Reverse	S
Great Valley 3, Mysterious Ridge	96.9	7.1	Reverse	S
Great Valley 4a, Trout Creek	79.48	6.6	Reverse	S
Great Valley 4b, Gordon Valley	54.65	6.8	Reverse	S
Great Valley 5, Pittsburg Kirby Hills	45.94	6.7	Strike Slip	SW
Great Valley 7	59.92	6.9	Reverse	W
Great Valley 8	98.01	6.8	Reverse	NW
Great Valley 9	132.06	6.8	Reverse	NW
Green Valley Connected	27.44	6.8	Strike Slip	SW
Greenville Connected	39.19	7	Strike Slip	W
Greenville Connected U	39.19	7	Strike Slip	W
Hayward-Rodgers Creek	6.46	7.334	Strike Slip	SW
Hosgri	187.29	7.3	Strike Slip	N
Hunting Creek-Berryessa	74.99	7.1	Strike Slip	S
Maacama-Garberville	96.21	7.4	Strike Slip	SE
Monte Vista-Shannon	38.07	6.501	Reverse	N
Monterey Bay-Tularcitos	96.2	7.3	Strike Slip	N
Mount Diablo Thrust	23.57	6.7	Reverse	SW
Northern San Andreas	22.69	8.05	Strike Slip	NE
Ortigalita	103.19	7.1	Strike Slip	NW
Point Reyes	53.56	6.9	Reverse	E
Quien Sabe	123.56	6.6	Strike Slip	NW
Rinconada	130.59	7.5	Strike Slip	N
SAF - creeping segment	128.25	6.7	Strike Slip	NW
San Andreas Creeping Section Gridded	90.27	6	Strike Slip	NW
San Gregorio Connected	29.89	7.5	Strike Slip	E

SOURCE	CLOSEST DISTANCE (km)	MOMENT MAGNITUDE (M_W)	FAULT MECHANISM	SITE LIES
Shear 1 Gridded	133.43	7.6	Strike Slip	SW
West Napa	42.74	6.7	Strike Slip	S
Zayante-Vergeles	80.87	7	Strike Slip	N

A total of four attenuation equations from the Next Generation Attenuation West 2 (NGA West 2) project were used. These include Abrahamson et al. (2014), Boore et al. (2014), Campbell and Bozorgnia (2014), and Chiou and Youngs (2014). All four empirical attenuation equations were for a spectral damping of 5 percent and were assigned equal weights (0.25) in the analyses.

Deterministic Analysis

The deterministic analysis involves developing the 84th percentile geometric mean response spectrum for a spectral damping of 5 percent of critical damping using the sources in Table 1 and the aforementioned attenuation equations (NGA West 2). The gridded seismic sources were not included in the deterministic evaluation. Based on the analysis, the deterministic ground motions are governed by a magnitude 7.3 earthquake on the Hayward fault with a closest distance to the site of approximately 6.5 km.

Resulting Base Spectra

The geometric mean values from EZFRISK were obtained and the maximum rotated factors were applied based on Shahi and Baker (2014). For PSHA, risk factors were also applied based on map values. Per ASCE 7-10, MCE_R is controlled by the lesser of the PSHA and 84th percentile of the DSHA. Exhibit 1 and Table 2 depict the recommended Site Class D MCE_R and DE response spectrum. The same exhibits show the DE response spectrum, which is 2/3 of the MCE_R. The DE level was then compared to 80 percent of the mapped spectrum and the maximum values were selected.

EXHIBIT 1: Site-Specific Response Spectra at the Base

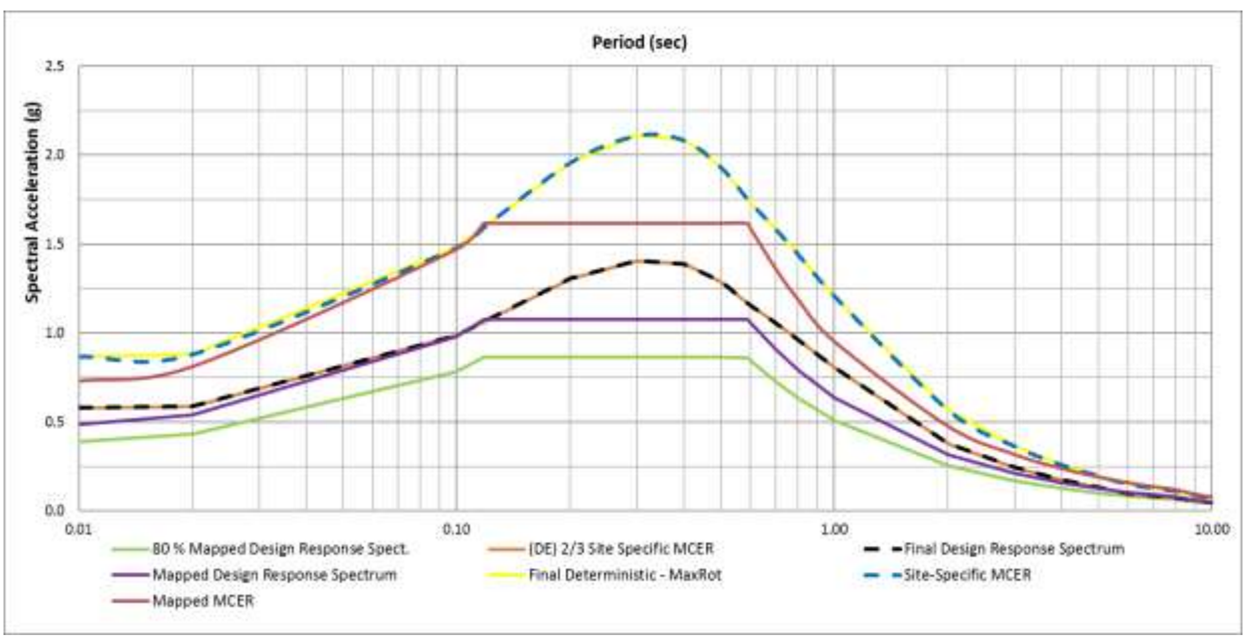


TABLE 2: Site-Specific Base Response Spectra (Site Class D – Stiff Soil)

PERIOD (SECONDS)	RECOMMENDED SPECTRAL ACCELERATION (G)	
	RISK TARGETED – MAXIMUM ROTATED MCE$_R$	MAXIMUM ROTATED DE
0.01	0.87	0.579
0.02	0.88	0.588
0.100	1.48	0.987
0.118	1.59	1.062
0.120	1.61	1.070
0.20	1.96	1.306
0.30	2.11	1.407
0.40	2.08	1.389
0.500	1.93	1.289
0.589	1.75	1.169
0.60	1.73	1.156
0.70	1.58	1.056
0.80	1.45	0.964
1.00	1.21	0.807
2.00	0.57	0.379
3.00	0.37	0.244
4.00	0.26	0.174
5.00	0.20	0.132
6.00	0.15	0.100
7.00	0.13	0.086
8.00	0.11	0.075

Horizontal Ground Motion Selection and Matching

Seven pairs of recorded ground motions were selected as seed motions. The motions were then matched to the recommended DE response spectrum shown on Exhibit 1. In developing the input stiff soil motions for our site-response analysis, time histories that reflect the potential ground motions at the site were selected. The NEHRP report titled “Selecting and Scaling Earthquake Ground Motions for Performing Response-History Analysis”, dated November of 2011, suggests that the most important factors affecting an analysis using recorded ground motions, is the spectral shape, and the existence of a velocity pulse. In addition, the effective duration, magnitudes and peak ground acceleration are also of importance. Another factor affecting earthquake records is fault type. It is of note that the main rupture mode of the Hayward Fault is a strike slip, but oblique faulting from the main trace of the Hayward fault is also possible. As an example, the 1989 Loma Prieta earthquake was on a reverse-oblique fault off the San Andreas main trace. By selecting four motions that represent a strike-slip fault, and three that represent reverse/normal faulting, the ranges of potential faulting events at the site have been encapsulated.

Due to proximity of the site to active faults, three of the seven seed motions were selected to have a velocity pulse. In identifying pulse-like motions, the PEER Ground Motion Database was used, which uses the procedure developed by Shahi and Baker (2010). The pulse characteristics were retained after the matching process had been completed.

The selected ground motions are listed in Table 3. The initial and matched 5 percent response spectra of the selected ground motions are shown in Appendix A.

TABLE 3: Selected Ground Motions for Horizontal Spectral Matching

NO.	EARTHQUAKE	NGA #	PULSE PERIOD (sec)	MAG. (M_W)	R_{rup} (km)	FAULT TYPE	V_{S30} (m/sec)	$D_{5\text{-}95}$ (sec)	PGA (g)
1	Imperial Valley-06	164	-	6.53	15.2	strike slip	472	36.4	0.23
2	Landers	850	-	7.28	21.8	strike slip	359	31.7	0.23
3	Northridge-01	1004	0.93	6.69	8.44	Reverse	380	8.50	1.20
4	Chi-Chi, Taiwan	1495	-	7.62	6.34	Reverse Oblique	359	26.8	0.32
5	Duzce, Turkey	1602	0.88	7.14	12.0	strike slip	294	9.00	1.11
6	Iwate, Japan	5780	-	6.90	20.8	Reverse	346	15.1	0.45
7	Darfield, New Zealand	6911	9.92	7.00	7.29	strike slip	326	9.50	0.66

Seismic Site-Response Analysis

Site response analysis were performed for three areas of the site as a function of the thickness of the soft soils, specifically the thickness of Young Bay Mud (Exhibit 4). One-dimensional (1-D), site-specific site response analysis using the computer program DEEPSOIL (Hashash et al., 2016) was performed.

One-Dimensional Site Response

The 1-D equivalent linear site response analyses were performed to develop seismic demand for the wharf's inertial response. Based on the collected data in the previous explorations, shear wave velocity profiles were developed for use in the 1-D soil column. The shear strain modulus reduction and damping functions were developed in accordance with Darendeli (2001), and by using the laboratory results from the publicly available data from the design of the new eastern span of the Bay Bridge.

Exhibit 3 (a, b and c) presents the average non-linear response spectra for the three zones (Exhibit 4) at the wharf locations. The spectra are compared to the 80-percent cap of the design mapped spectra based on ASCE 7-10. The recommended DE spectra is the envelope of the 80-percent cap and the site-response.

EXHIBIT 3: Summary of DE Response Spectra (a)

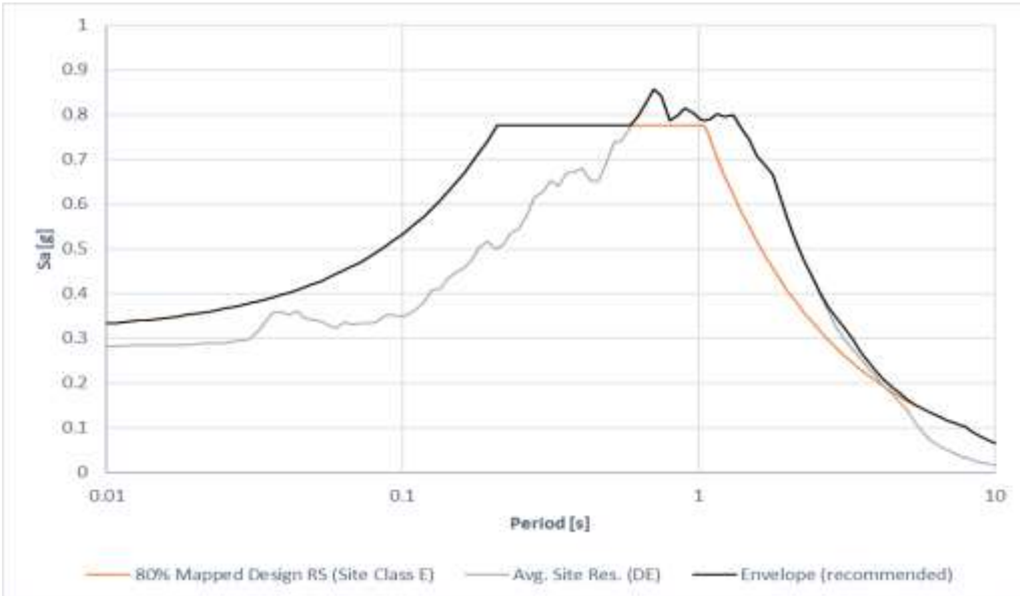


EXHIBIT 3: Summary of DE Response Spectra (b)

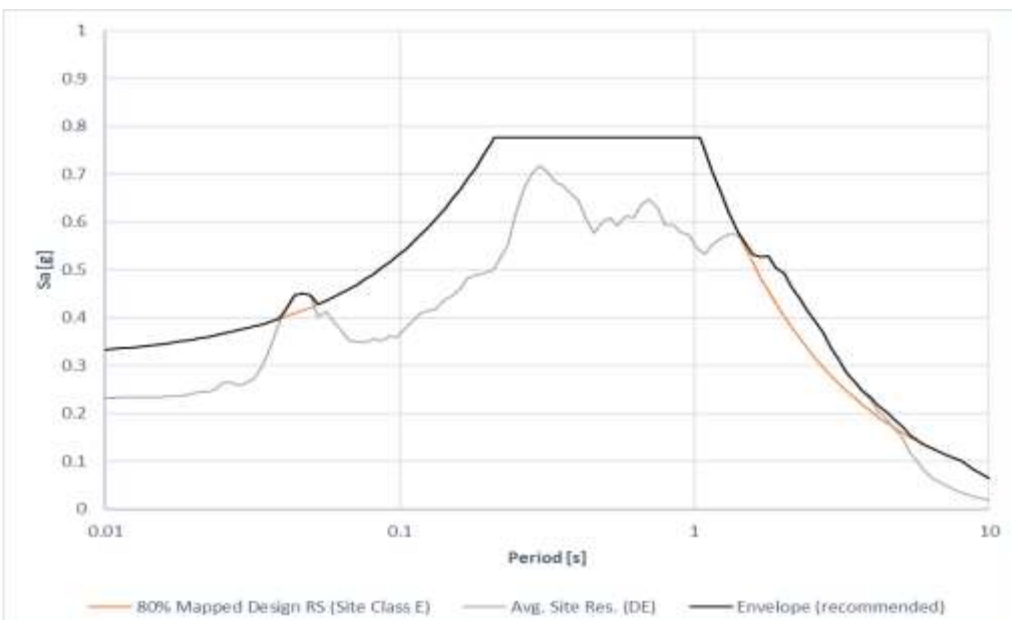


EXHIBIT 3: Summary of DE Response Spectra (c)

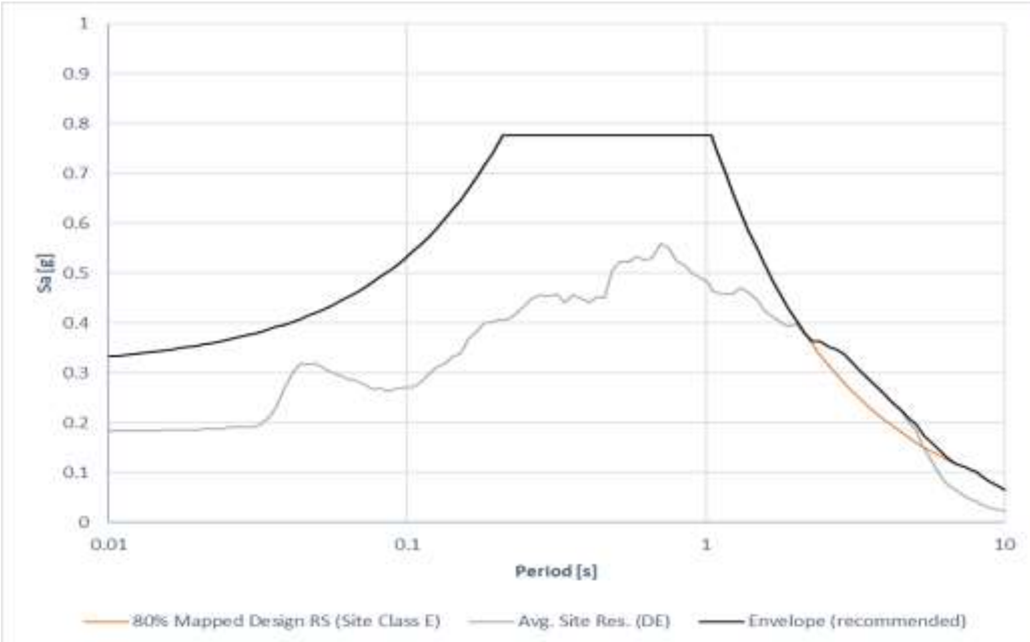
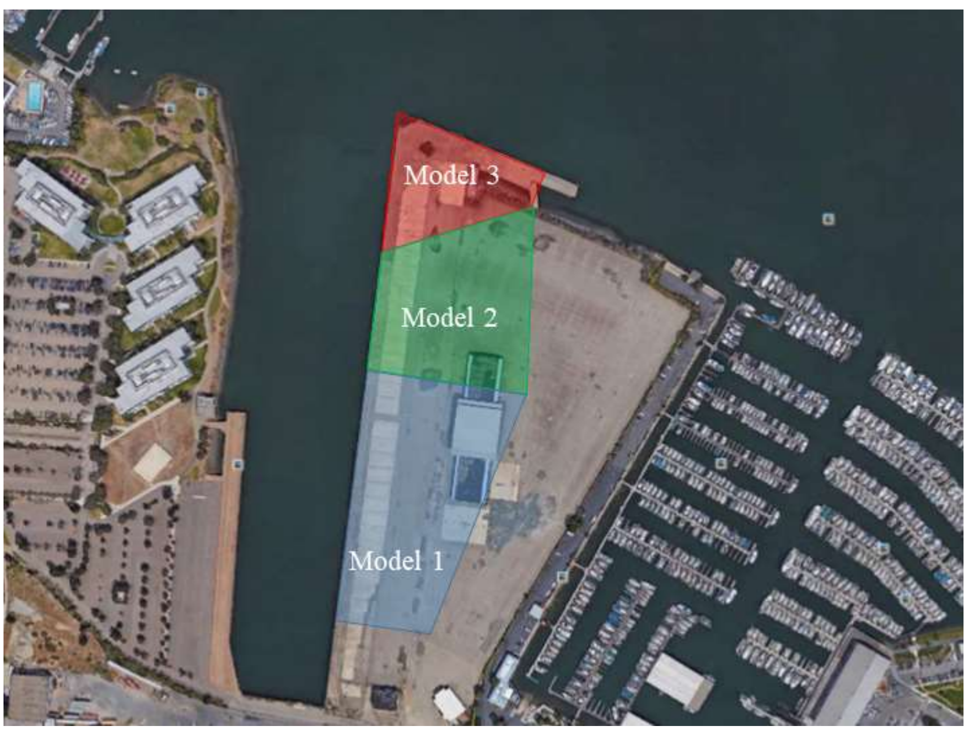


EXHIBIT 4: Schematic Showing Areas of Site Response



SLOPE STABILITY ANALYSIS – LIMIT EQUILIBRIUM

A simplified deformation analysis was performed using the computer program SLIDE (Version 6) to evaluate seismic stability using "pseudostatic" methods, and potential seismic deformation was estimated using simplified displacement analyses to index stability of the perimeter of the site. SLIDE is a limit equilibrium program that allows the user various search routines to locate the minimum factor of safety and critical slip surface. For our analysis, Spencer's Method (Spencer, 1967) was used. Circular searching methods were used to analyze the existing conditions. In performing our analyses, a groundwater level of approximately 9 feet below existing ground surface, water level in the Alaska Basin at approximately Mean Sea Level, a peak ground acceleration (PGA) of 0.33g per the results of our DE site-specific ground response analysis, and a moment magnitude (M_w) of 7.3 were used.

A "pseudostatic" screening analysis was used as recommended in the California Geological Survey's (CGS) SP117A "Guidelines for Evaluating and Mitigating Seismic Hazards in California". To estimate displacement, the procedures in the publication "Seismic Analysis and Design of Retaining Walls, Buried Slopes, and Embankments," by the National Cooperative Highway Research Program Report 611 (NCHRP, 2008) were used. Specifically, a wave scattering coefficient of 0.9 per Figure 6-13 in NCHRP 611 was used. In addition, a reduction of the resulting k_{max} of 50 percent per the commentary in section 8.3.1 of the NCHRP report was applied. The resulting k_h for the pseudostatic checks was approximately 0.15g; due to limitations of this method, actual deformations will be on the order of 2 to 6 inches, approximately.

Along the western and northern portions of the site (Sections 1 through 6), the slopes did not pass this check and deformations into the proposed building areas are anticipated to be over 1 foot without mitigation. Along the eastern side of the site (Sections 7 and 8), the proposed buildings are set back approximately 50 to 100 feet from the shoreline. The area between the shoreline and the building area is occupied by parking and drive areas related to the adjacent Fortman Marina; this roadway and parking are off the developable property and are owned by others. Section 8 was selected as the most critical condition along the eastern shoreline, due to the thickness of the Young Bay Mud. Analysis of Section 8 is attached in Appendix B.

Prior to performing slope stability analyses, the shear strength of the soil profile was evaluated. To obtain shear strength data, in-situ Standard Penetration Tests (SPTs), in-situ Cone Penetrometer Tests (CPTs), Unconsolidated Undrained Triaxial Compression Tests, Laboratory Miniature Vane Shear Tests and laboratory index tests were performed. The lab strength and in-situ data were compared with empirical correlations of SPT blow counts, plasticity index (PI) and soil type. Based on the data review, idealized soil profiles were developed. The following table summarizes the strength parameters used for each soil layer:

TABLE 4

SOIL LAYER	UNIT WEIGHT	COHESION (PSF)	FRICTION ANGLE (DEG)	NOTES
Fill	120	0	38	
Young Bay Mud (crust inland)	110	600	0	Overconsolidated due to marsh and past site use
Young Bay Mud (inland)	100	420 + 10 psf/foot	0	Overconsolidated due to past site use and minor surcharging when converted to storage for shipping containers

SOIL LAYER	UNIT WEIGHT	COHESION (PSF)	FRICTION ANGLE (DEG)	NOTES
Young Bay Mud *	90	100 + 10 psf/foot	0	
Old Bay Clay	110	2000	0	

WESTERN AND NORTHERN SHORELINE DEEP SOIL MIXING

Initial analyses of the cross sections along the western and northern shorelines indicate that excessive seismic deformations could occur in the existing condition. A Deep Soil Mix (DSM) buttress was added to our slope stability models to mitigate movement in these areas. To analyze the effectiveness of a DSM buttress in reducing potential displacement to acceptable ranges, pseudostatic analyses of a buttress extending to the bottom of the Young Bay Mud layer with a width to height ratio of $^3/_4$:1, were performed. The DSM would consist of below-ground shear walls created by overlapping columns of in-situ soil mixed with water and cement. The resulting shear walls would be oriented perpendicular to the shoreline. The shear strength of the mixed soil would be approximately 100 psi; this would result in an average shear strength of the mixed zone of approximately 5,000 psf (assuming 30-percent replacement ratio).

To analyze the stability of the buttress concept, a block search for failure surfaces that pass underneath and through the DSM buttress, were performed. Additionally, circular surfaces passing under the buttress were searched. The results of the analysis of one of the northern cross-section (Section 5) was used to confirm the general approach. This cross section was selected due to the presence of relatively thick Young Bay Mud. Attached in Appendix B is the output of these analyses showing the critical surfaces from each search of Section 5. The results of these analyses indicate that seismic displacements behind and through the DSM should be less than 6 inches.

The design of the DSM buttress will still need to be refined with additional analysis to confirm final dimensions and layout based on type of equipment proposed by the contractor that will perform the work. The criteria should consider similar displacements to those discussed in this section as well as internal and external stability checks. ENGEO should be retained to work with the contractor to refine and optimize the design of the DSM buttress. ENGEO should be retained to review the deep soil mixing contractor submittals.

The DSM buttress should be integrated with the land plan. Due to differential site response movement of the DSM buttresses and the unimproved soil, it is recommended that any building on a shallow foundation be entirely supported on or off the DSM zone. If this is infeasible due to land planning constraints, then the interaction between the buildings, the DSM buttress and the unimproved soil should be further analyzed. Buildings that straddle the DSM zone and unimproved soil behind will likely need to be supported of deep foundations.

Non-Linear Plaxis Analysis

The design team selected to evaluate the slope movement below the wharf in more detail to refine the estimated kinematic loading on the structure. The two-dimensional (2D) Finite Element Model (FEM) dynamic analysis was used to refine the strain-stress behavior and potential kinematic loads at the wharf piled-foundations during ground shaking. As inputs for the 2D non-linear FEM analysis, the outputs from the 1D non-linear site response described previously in this report were used.

Plaxis is a two-dimensional finite element program for geotechnical and other applications developed by Plaxis BV (2012). The analysis input motion is specified at the base of the analysis section (150 to 200 feet below top of wharf), as a “outcropping” ground motion. The “outcropping” ground motions are the same as the 1D DeepSoil analysis described above.

Various constitutive soil models are available in Plaxis. The Mohr-Coulomb model was used for the non-linear seismic deformation analyses. The Mohr-Coulomb model consists of elastic-perfectly-plastic stress-strain relationships. Therefore, the materials are elastic before yielding. To make the elastic portion of the analysis reasonable, the outputs from DeepSoil were used to obtain the strain-compatible modulus and damping values for the shaking conditions. The analysis results from DeepSoil provide the basis for the strain-compatible shear modulus and damping values to be used in the elastic portion of the Mohr-Coulomb model in the Plaxis analyses. The "perfectly-plastic" portion of the Mohr-Coulomb model is specified as the appropriate shear strength of the material as presented on table 4.

Exhibits 5 through 7 show the meshed analyzed sections, and table 5 shows additional soil properties used on the Plaxis analysis.

EXHIBIT 5: Section 2-2 Mesh

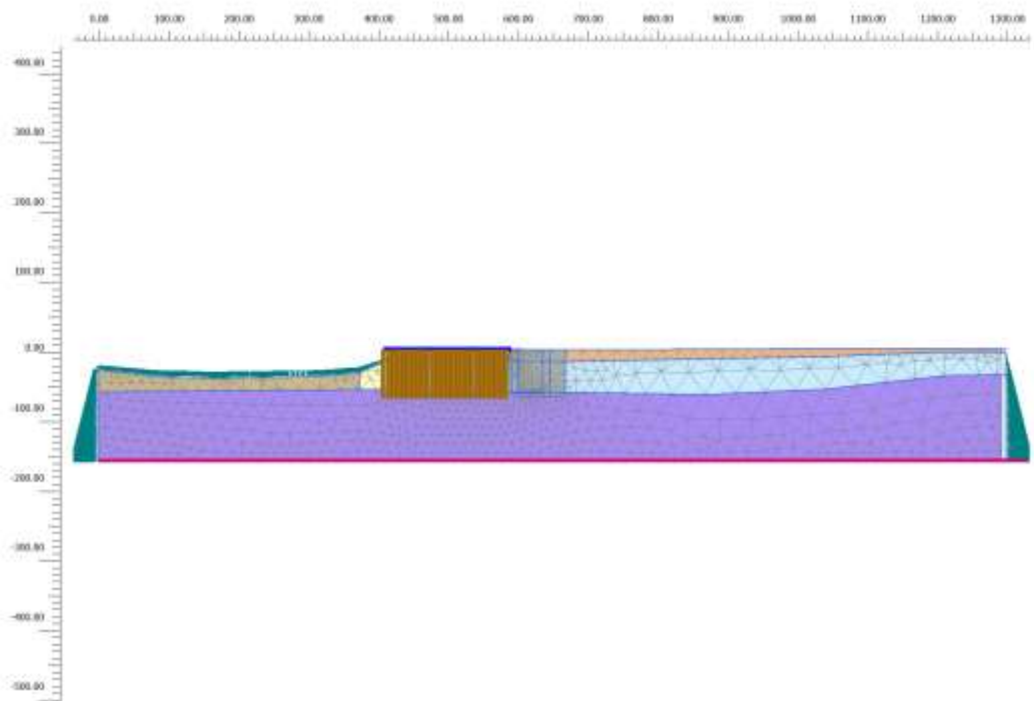


EXHIBIT 6: Section 3-3 Mesh

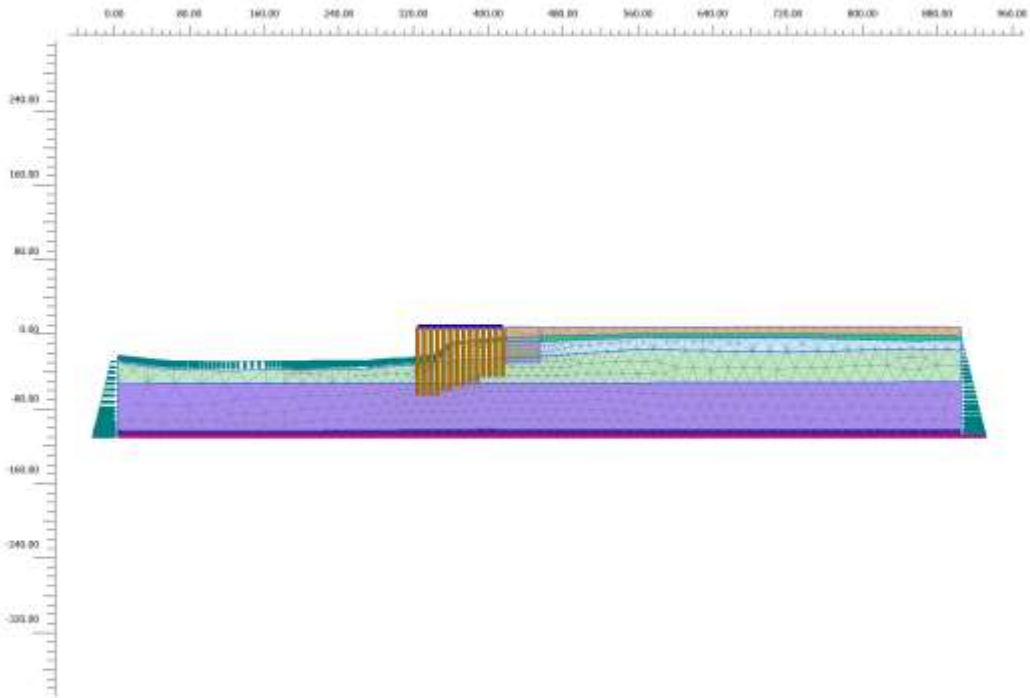


EXHIBIT 7: Section 4-4 Mesh

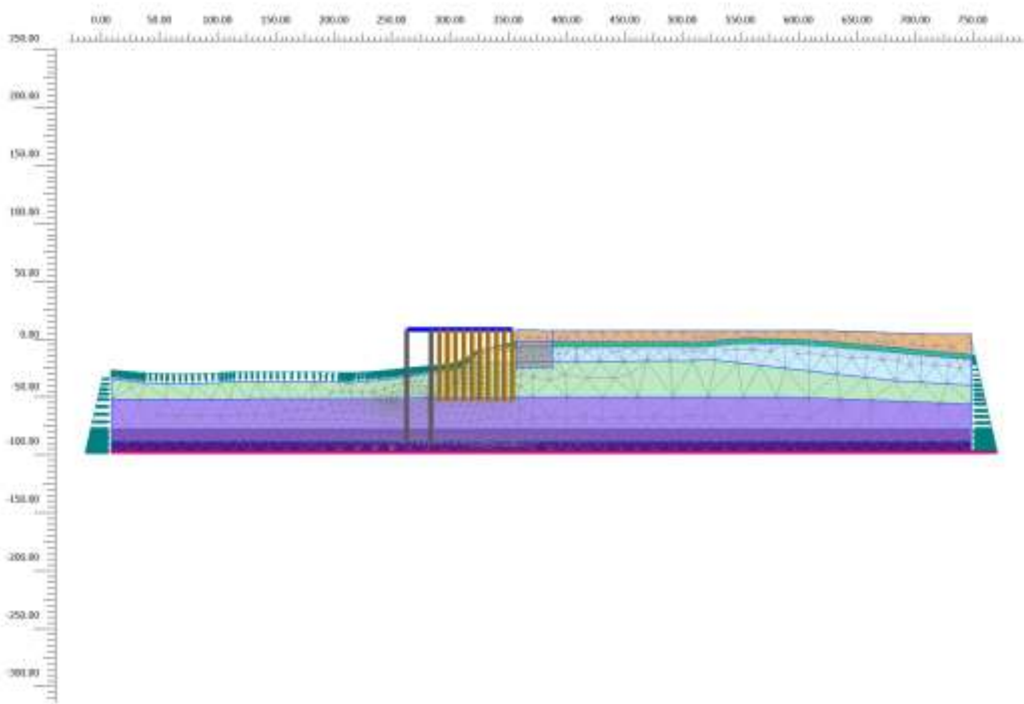


TABLE 5: Plaxis Additional Soil Parameters

MATERIAL MODEL DRAINAGE TYPE	UNITS	FILL MOHR-COULOMB DRAINED	CH-SC MOHR-COULOMB DRAINED	YBM (RANGE OF VALUES) MOHR-COULOMB UNDRAINED (B)	OBC MOHR-COULOMB UNDRAINED (B)
γ_{unsat}	lbf/ft^3	115	125	-	120
γ_{sat}	lbf/ft^3	115	125	100	120
Rayleigh α		0.4189	0.4189	0.1663	0.4189
Rayleigh β		0.02122	0.02122	8.43E-03	0.02122
E	lbf/ft^2	3.37E+06	2.19E+07	3.98E+04 - 7.57E+05	1.04E+07
G	lbf/ft^2	1.25E+06	8.74E+06	1.99E+04 - 2.70E+05	3.73E+06
c'_{ref}	lbf/ft^2	See Table 4	See Table 4	See Table 4	See Table 4
φ (phi)	°	See Table 4	See Table 4	See Table 4	See Table 4
V_s	ft/s	590	1000	80-300	800-900
$K_{0,x}$		0.38	0.44	0.65	0.65
$K_{0,z}$		0.38	0.44	0.65	0.65

Plaxis uses Rayleigh Damping formulations with two-frequency scheme. This results in under-damping between these frequencies and over-damping outside of this range. The frequencies are a function of the earthquake's predominant period and the period of the soil mass. The frequencies used for these analyses were 0.1 Hz and 7.5Hz.

The same ground motions as the 1D analysis were used at the bottom of the 2D models to evaluate average deformations at the foundations of the wharf. Exhibits 8 through 10 show a sample of the deformation distribution at the bottom of wharf for a selected ground motion. Exhibit 11 shows the resulting deformations at the middle of the wharf for each section analyzed. Additional deformation-profiles were provided to the marine structural engineers, to evaluate kinematic loads on the wharf foundations. The averaged deformations for the soils under the wharf within the areas of historical dredging, is shown to be less than 1 foot. The deformations north of the historical shoreline, and where the thickness of the YBM is up to 50 feet, are shown to be in excess of 3 feet. Kinematic loads should be added to inertial loads. Kinematic loading, however, does not occur at the same time or elevation as the inertial loading. Therefore, it is common not to apply 100-percent of both loads when superimposing them. On other similar projects, for example, structural engineers have added a quarter of the inertial load to the kinematic load when superimposing the two conditions.

EXHIBIT 8: Section 2-2 Horizontal Displacement Landers

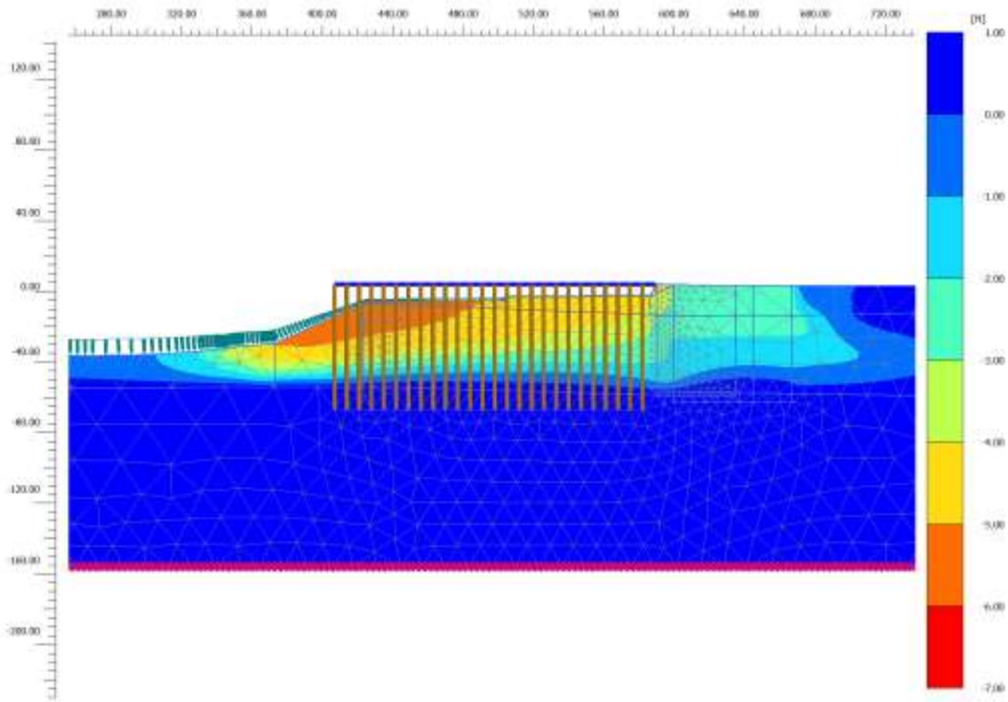


EXHIBIT 9: Section 3-3 Horizontal Displacement Iwate

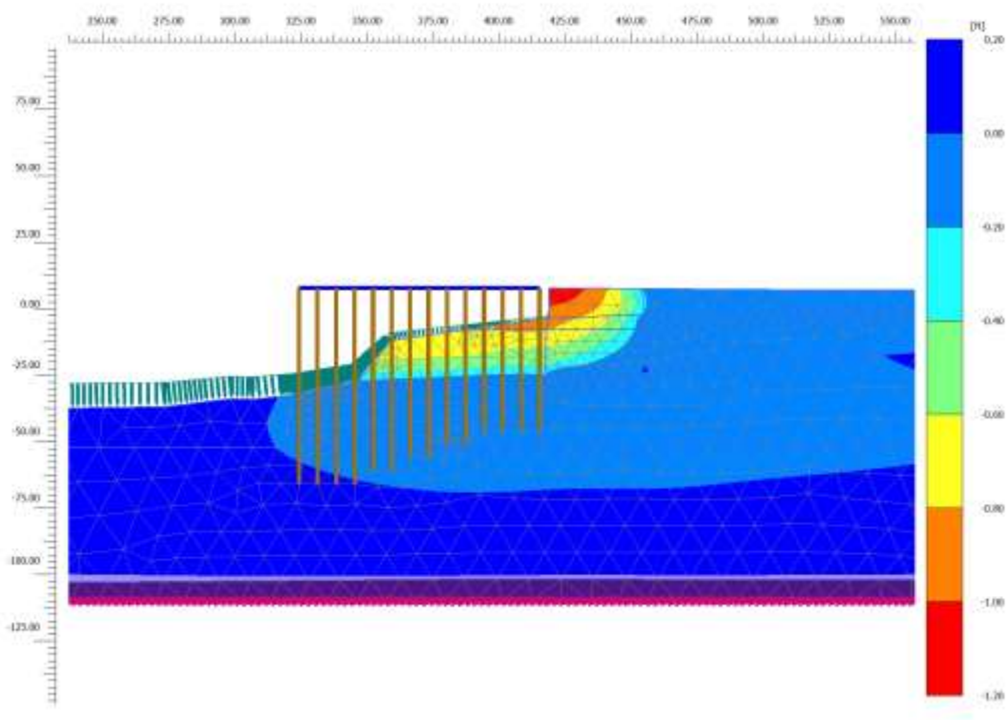


EXHIBIT 10: Section 4-4 Horizontal Displacement Landers

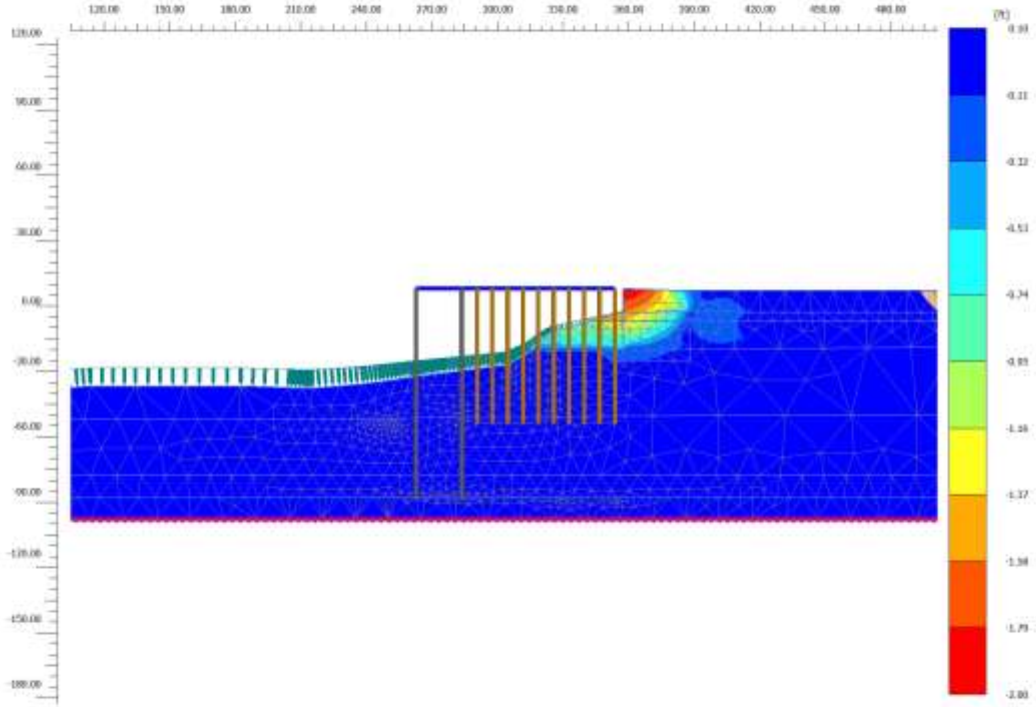


EXHIBIT 11: Section 2-2 Horizontal Displacement At Middle of Pier

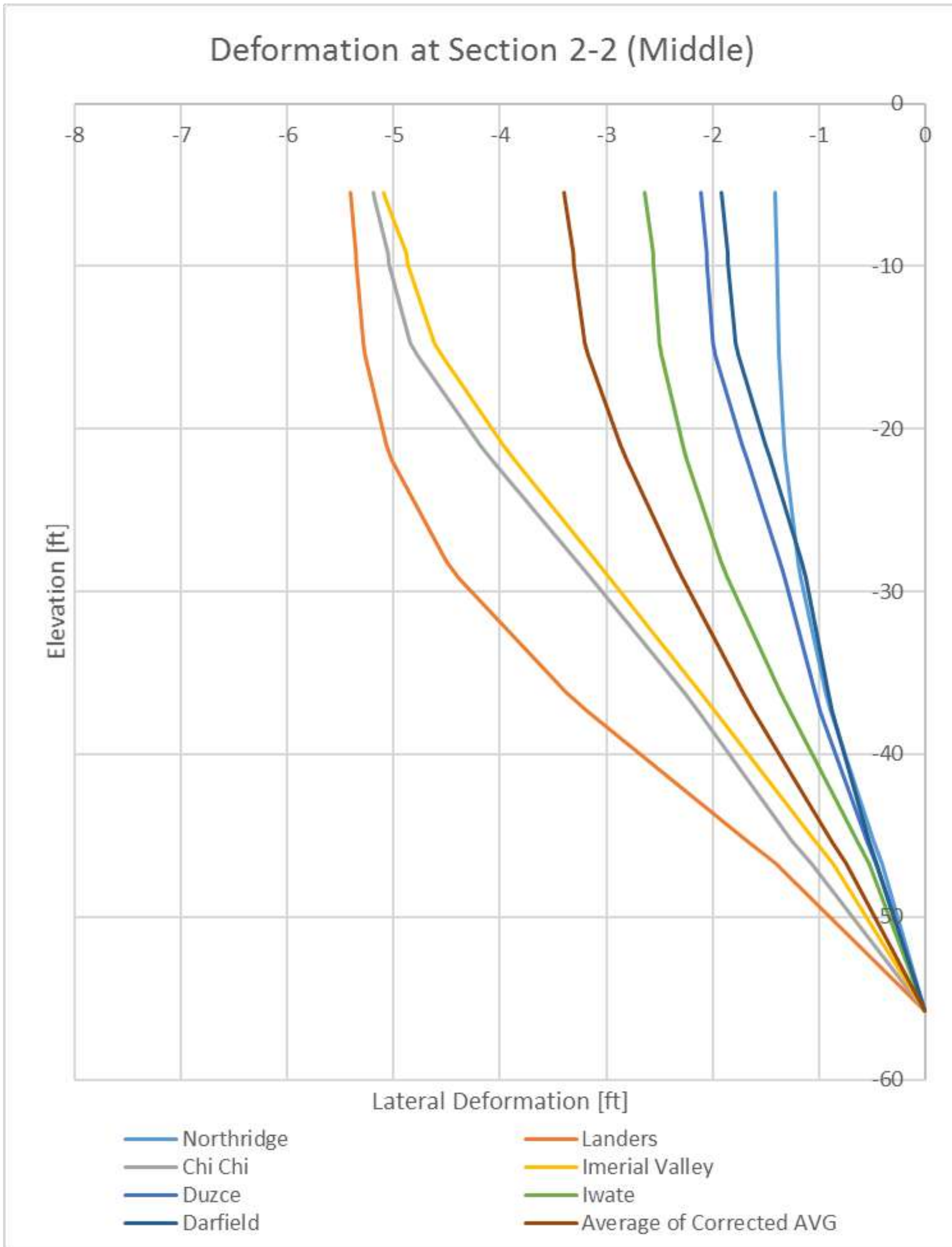


EXHIBIT 12: Section 3-3 Horizontal Displacement At Middle of Pier

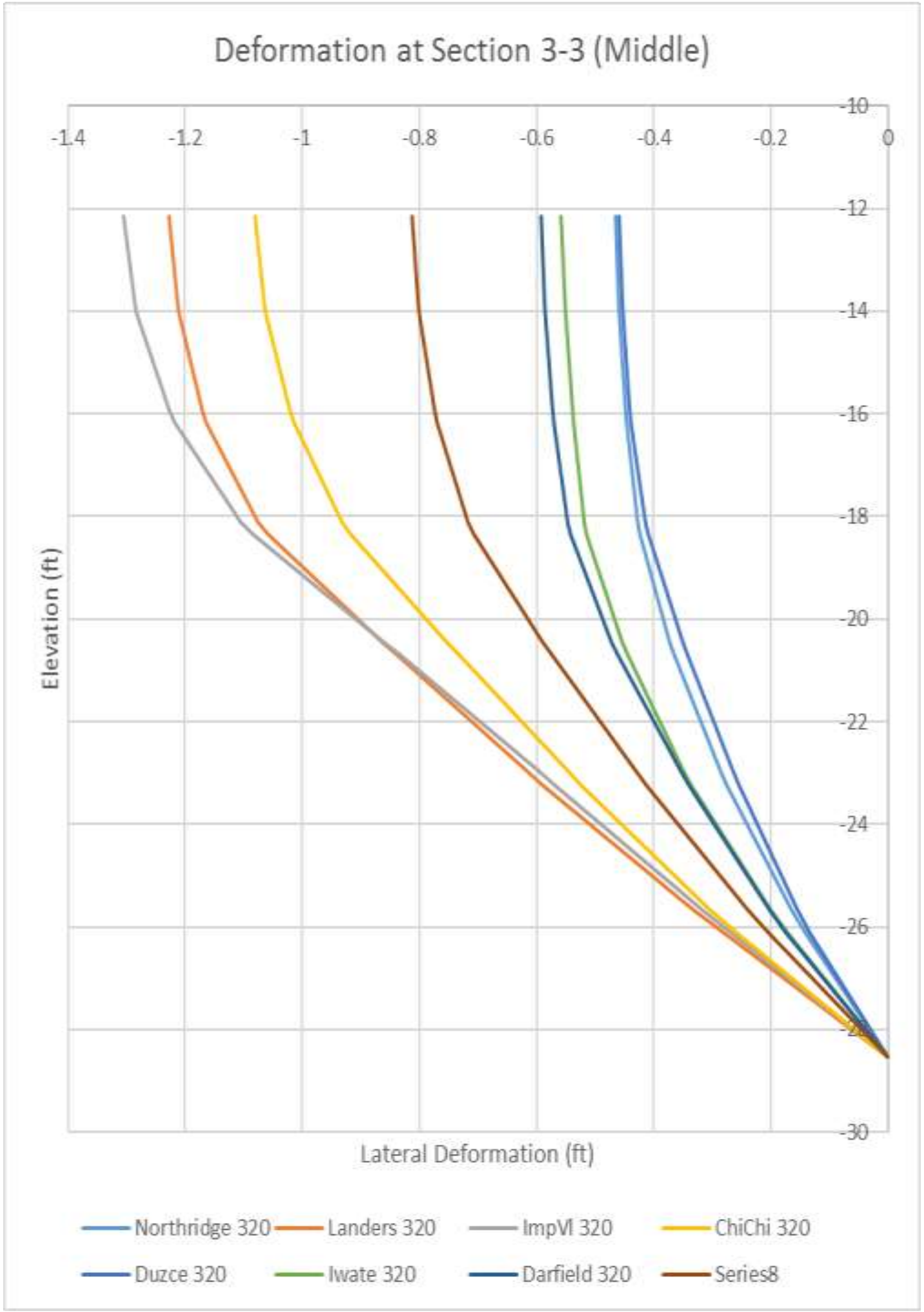
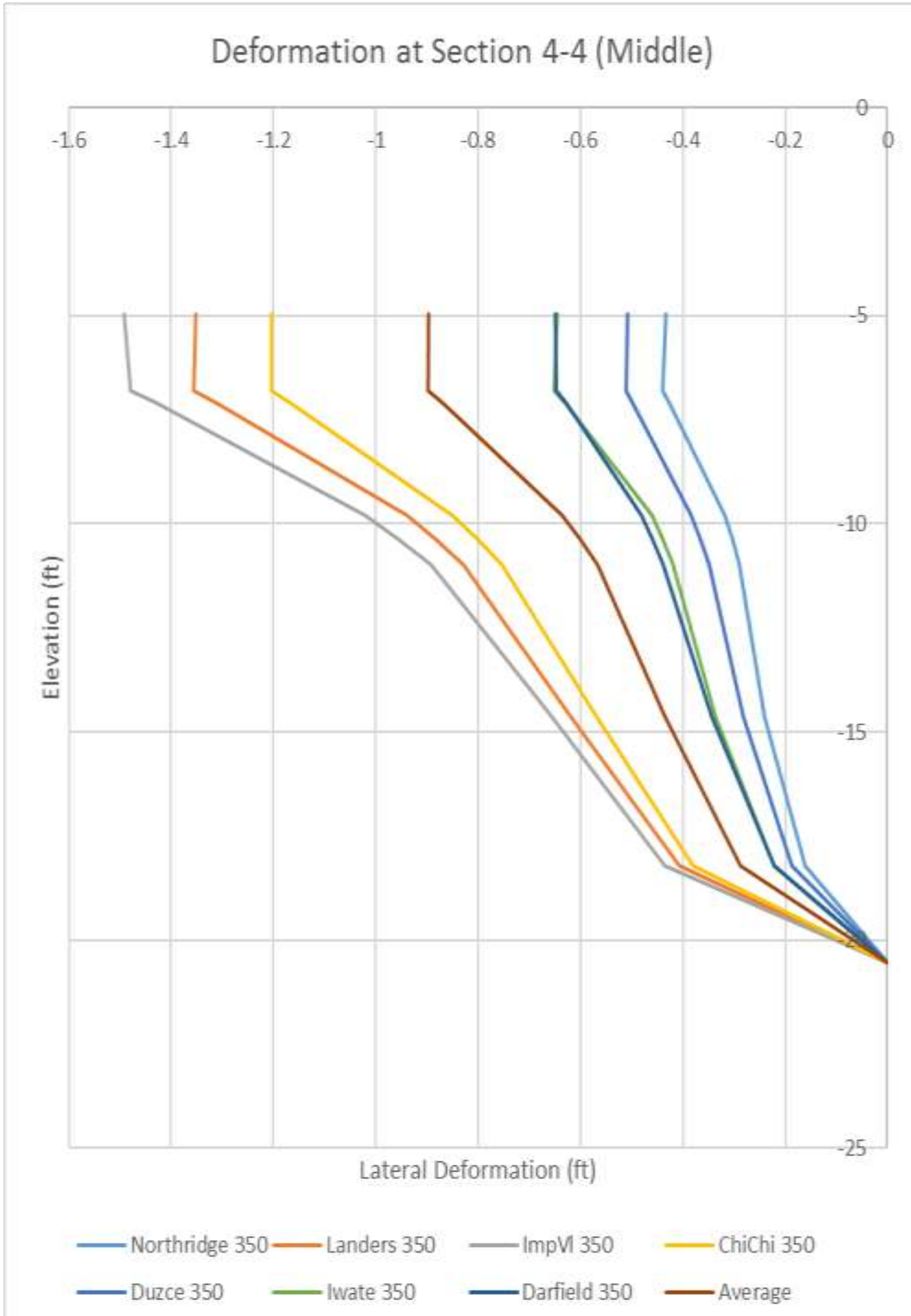


EXHIBIT 13: Section 4-4 Horizontal Displacement At Middle of Pier



SOIL-STRUCTURE INTERACTION

The wharf structure is founded on deep piles. For the purposes of estimating the soil reaction to lateral loads, generalized profiles were prepared allowing development of lateral soil-structure load-deflection “springs” (p-y springs). We developed the springs for timber piles to represent the interaction of the pile with soil. The computer software LPILE Plus 5.0 by Ensoft Inc. was used for the preparation of p-y springs based on published models of soil-structure interaction. The following parameters were used in our analyses.

TABLE 6: Parameters Used in p-y Spring Development

SOIL TYPE	SOIL MODEL	EFFECTIVE UNIT WEIGHT (PCF)	UNDRAINED STRENGTH – LINEAR INCREASE (PSF)	PHI (DEG)	K (PCI)	ε_{50}
Fill	API Sand	60	-	38	Default	-
Young Bay Mud	Soft Clay (Matlock)	27.6	100 + 10/foot	-	-	Default
Old Bay Clay	Stiff Clay (no free water)	58.7	2000	-		Default
Alluvium	API Sand	60	0	40	Default	

Upper bound and lower bound of the springs were developed using the soil parameters above. The spring output was simplified by matching the curved shape with four points for ease of use by the marine structural engineer. The springs are attached in Appendix D.

The axial capacity of existing piles was also assessed. Springs that represent the load-deflection of the pile in both side friction (t-z) and end bearing (q-w) were developed using the computer software APILEPlus Version 5. Upper and lower bound estimates for the springs were developed. The springs are attached as Appendix E.

We are pleased to be of service on this project. If you have any questions or comments regarding this letter, please call and we will be glad to discuss them with you.

Sincerely,

Pedro Espinosa, GE

Jeff Fippin, GE

Attachments: Selected References
Figures
Appendix A – Seed Ground Motions and Dynamic Properties
Appendix B – Existing Condition Seismic Slope Stability at Section 8-8
Appendix C – Analysis of DSM Buttress Section 6-6
Appendix D – P-Y Springs
Appendix E – Axial Capacities

SELECTED REFERENCES

1. Anderson, et al., 2008, Seismic Analysis and Design of Retaining Walls, Buried Slopes, and Embankments, National Cooperative Highway Research Program (NCHRP) Report 611, Transportation Research Board, Washington, D.C., 137p.

2. Bray, J.D. and Travasarou, T., 2007, Simplified Procedure for Estimation Earthquake Induced Deviatoric Slope Displacements, Journal of Geotechnical and Geoenvironmental Engineering, ACSE, V. 133 (4), pp. 381-392, April 2007.

3. California Geological Survey, 2008, Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

4. ENGEO, 2012, Preliminary Geotechnical Report, Encinal Terminals, Alameda County, California, Project No. 9769.000.000, November 19, 2012.

5. ENGEO, 2017, Updated Geotechnical Report, Encinal Terminals, Alameda County, California, Project No. 9769.000.000, October 2, 2017.

6. Robertson, P. K. and R. G. Campanella, 1988, Guidelines for Geotechnical Design Using CPT and CPTU Data.

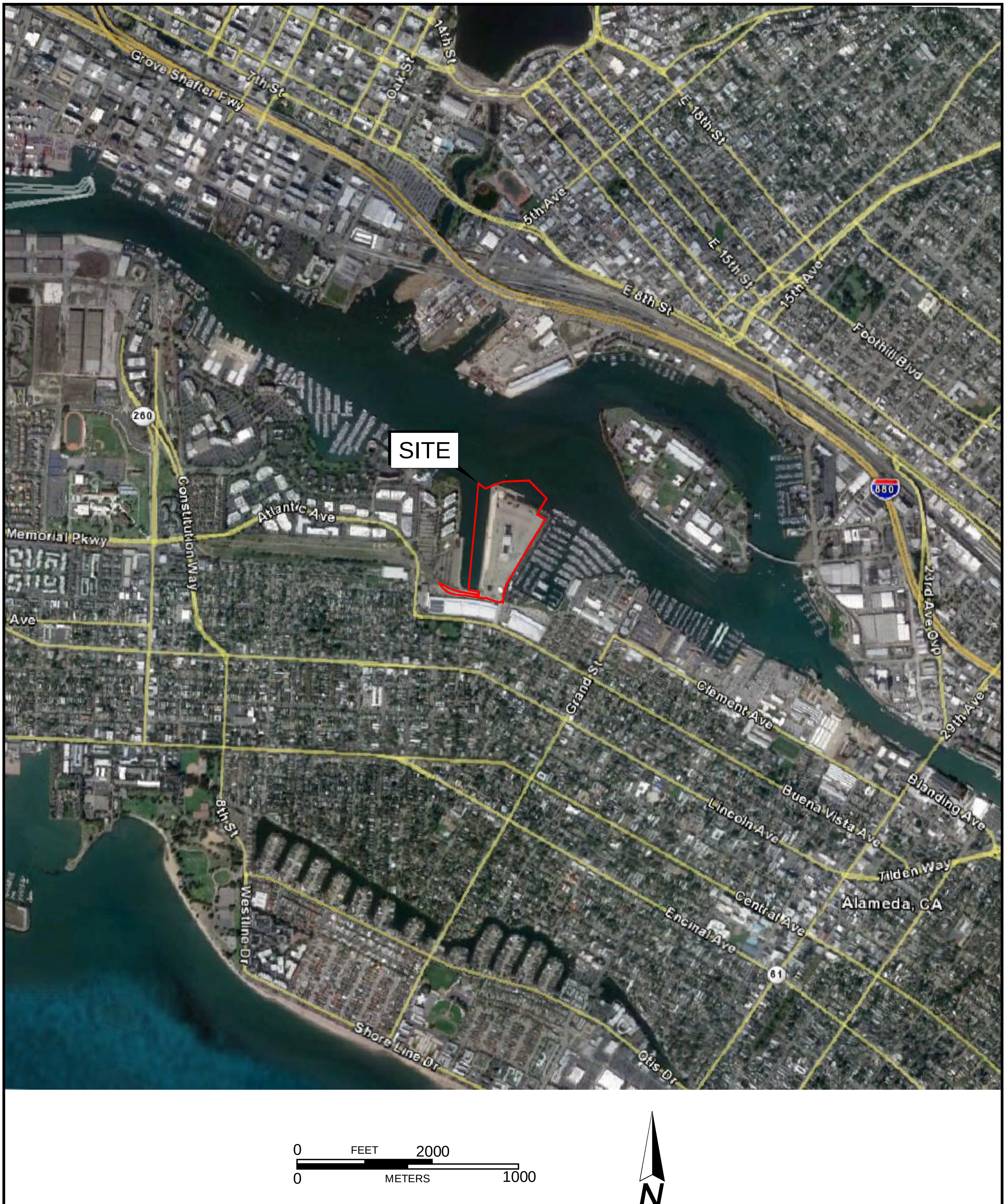
7. Spencer, E., 1967, A method of analysis of the stability of embankments assuming parallel inter-slice forces, Geotechnique, V. 17(1), pp. 11–26.

8. Stewart, J.P., Blake, T.F. and Hollingsworth, R.A., 2003, A Screen Analysis Procedure for Seismic Slope Stability, Earthquake Spectra, v.19, n.3, pp. 697-712.

.

FIGURES

9769.000.000
October 2, 2017



BASE MAP SOURCE: GOOGLE EARTH MAPING SERVICE

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VICINITY MAP
ENCINAL TERMINALS
ALAMEDA, CALIFORNIA

PROJECT NO.: 9769.000.000	
SCALE: AS SHOWN	
DRAWN BY: GLJ	CHECKED BY: JAF

FIGURE NO.
1

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ORIGINAL FIGURE PRINTED IN COLOR

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N

0 FEET 200
0 METERS 100

EXPLANATION

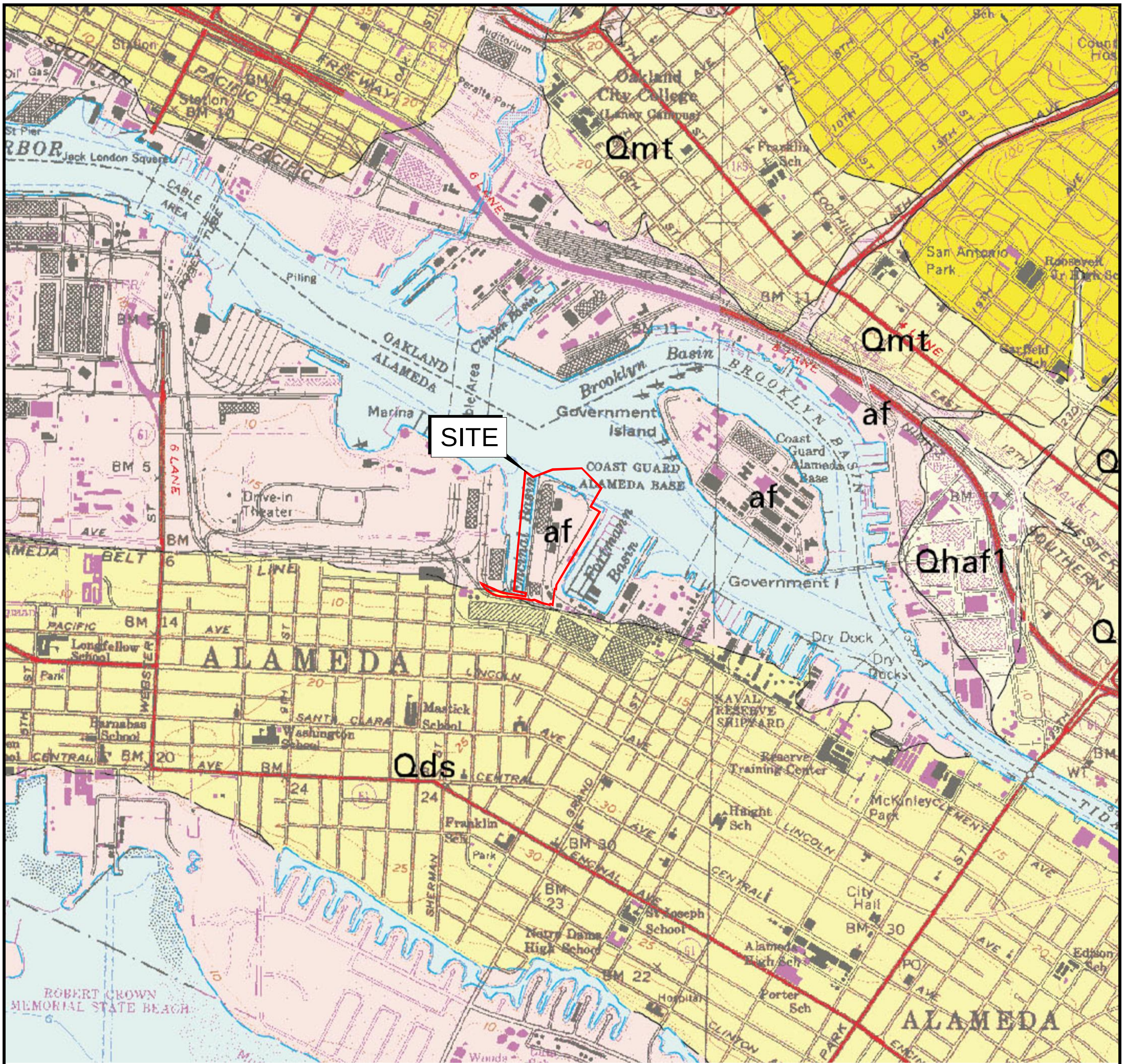
ALL LOCATIONS ARE APPROXIMATE

4-CPT05	CONE PENETRATION TEST (ENGEO, JULY 2013)		HISTORIC SHORELINE (1885)
3-CPT05	CONE PENETRATION TEST (ENGEO, JANUARY 2013)		SITE BOUNDARY
2-CPT05	CONE PENETRATION TEST (ENGEO, NOVEMBER 2012)	8 8'	CROSS SECTION LOCATION
B1-6	BORING (ENGEO, JANUARY 2013)		

BASE MAP SOURCE: GOOGLE EARTH MAPPING SERVICE

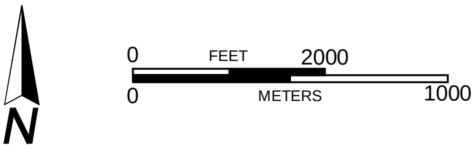
ENGEO Expect Excellence	SITE PLAN ENCINAL TERMINALS ALAMEDA, CALIFORNIA	PROJECT NO.: 9769.000.000 SCALE: AS SHOWN DRAWN BY: GLJ CHECKED BY: JAF	FIGURE NO. 2

ORIGINAL FIGURE PRINTED IN COLOR



EXPLANATION

af	**Artificial fill (Historic)**
Qhaf1	**Younger alluvial fan deposits (Holocene)**
Qds	**Dune sand (Holocene and Pleistocene)**
Qmt	**Marine terrace deposits (Pleistocene)**



BASE MAP SOURCE: GRAYMER, 2000

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REGIONAL GEOLOGIC MAP
ENCINAL TERMINALS
ALAMEDA, CALIFORNIA

PROJECT NO.: 9769.000.000	FIGURE NO. 3
SCALE: AS SHOWN	
DRAWN BY: GLJ	CHECKED BY: JAF

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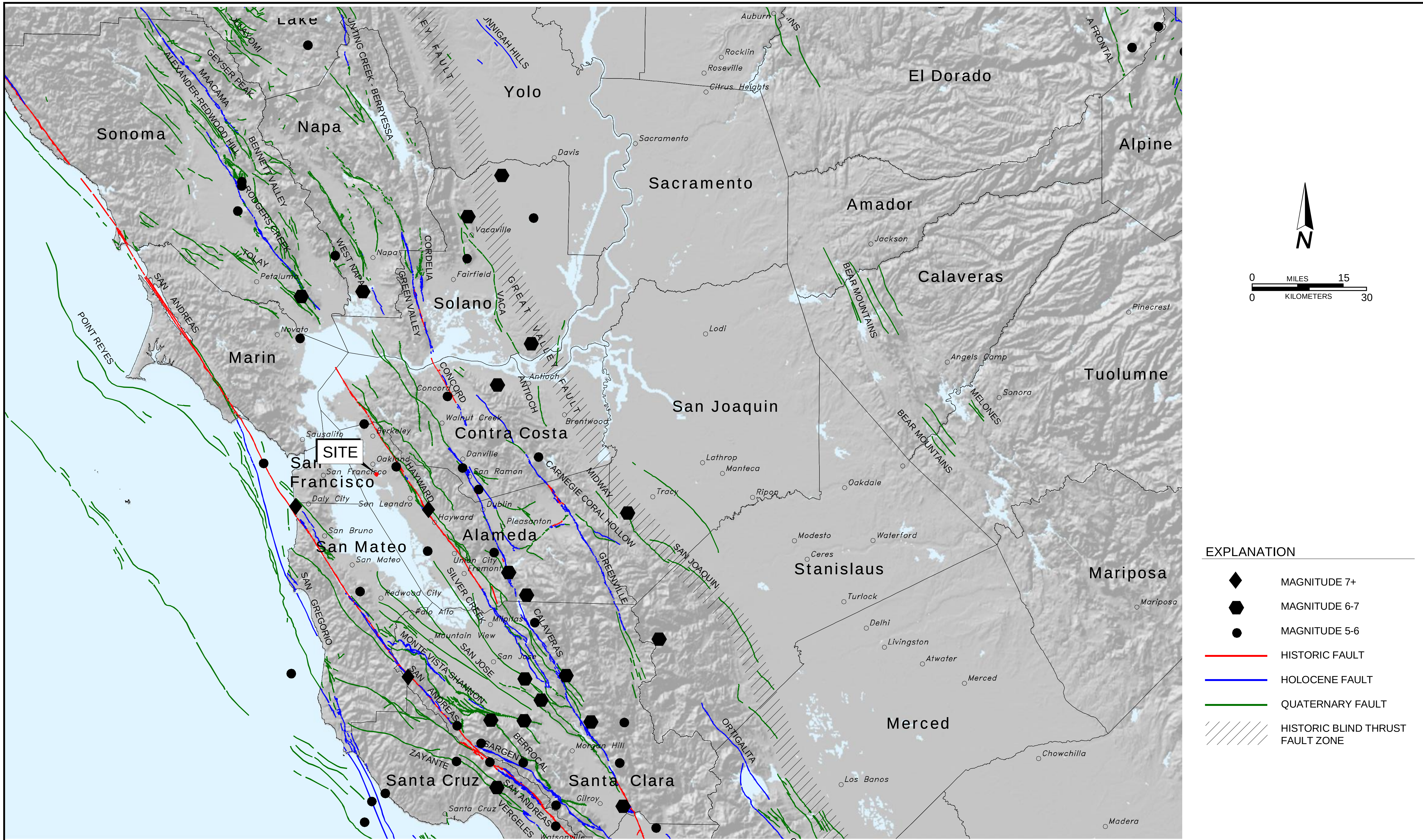

BASE MAP SOURCE:
U.S.G.S. 1-ARC SECOND S.R.T.M. DATABASE
U.S.G.S. QUATERNARY FAULT DATABASE, MARCH, 2006
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800–2000)

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ENCINAL TERMINALS
ALAMEDA, CALIFORNIA

PROJECT NO.: 9769.000.000	FIGURE NO. 4
SCALE: AS SHOWN	
DRAWN BY: DLB	CHECKED BY: JAF

ORIGINAL FIGURE PRINTED IN COLOR

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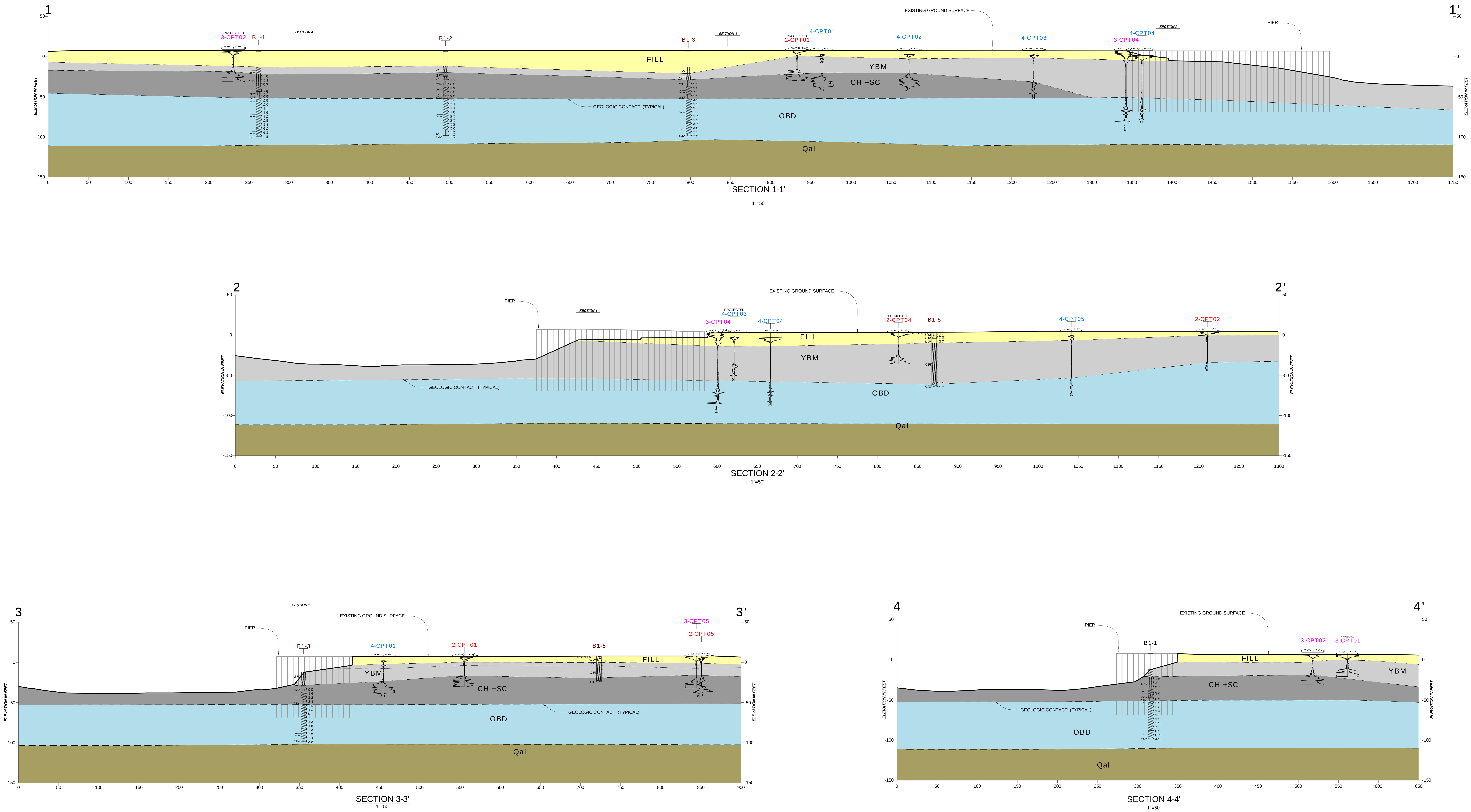

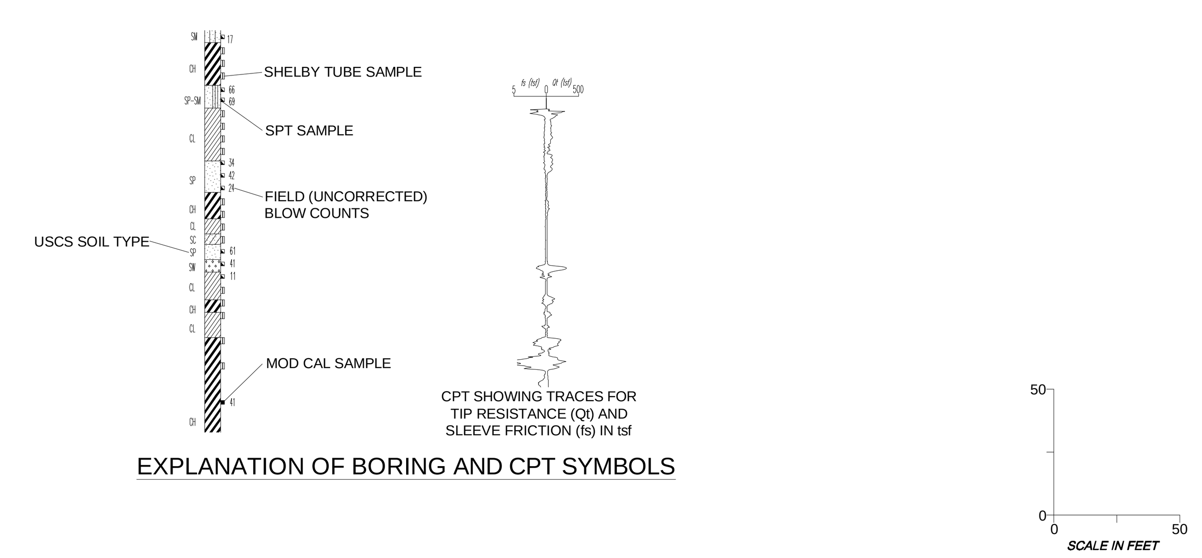

EXPLANATION OF BORING AND CPT SYMBOLS

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

FILL	ARTIFICIAL FILL
YBM	YOUNG BAY MUD (HOLOCENE)
CH + SC	INTERLAYERED ESTUARINE SANDS AND YOUNG BAY MUD (HOLOCENE)
OBD	OLD BAY DEPOSITS (PLEISTOCENE)
Qal	ALLUVIUM (PLEISTOCENE)
4-CPT05	CONE PENETRATION TEST (ENGEO, JULY 2013)
3-CPT05	CONE PENETRATION TEST (ENGEO, JANUARY 2013)
2-CPT05	CONE PENETRATION TEST (ENGEO, NOVEMBER 2012)
B1-6	BORING (ENGEO, JANUARY 2013)
SECTION 8	CROSS SECTION LINE

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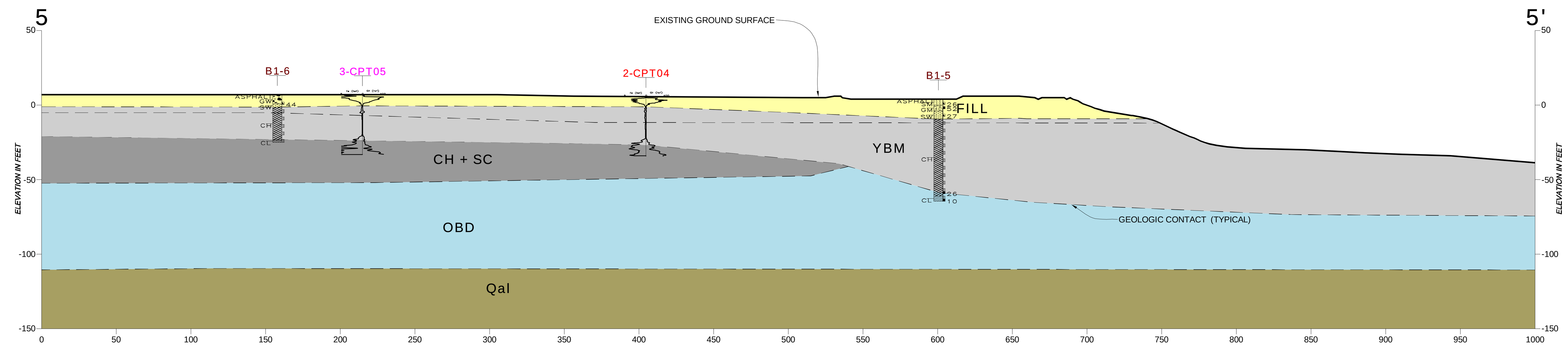
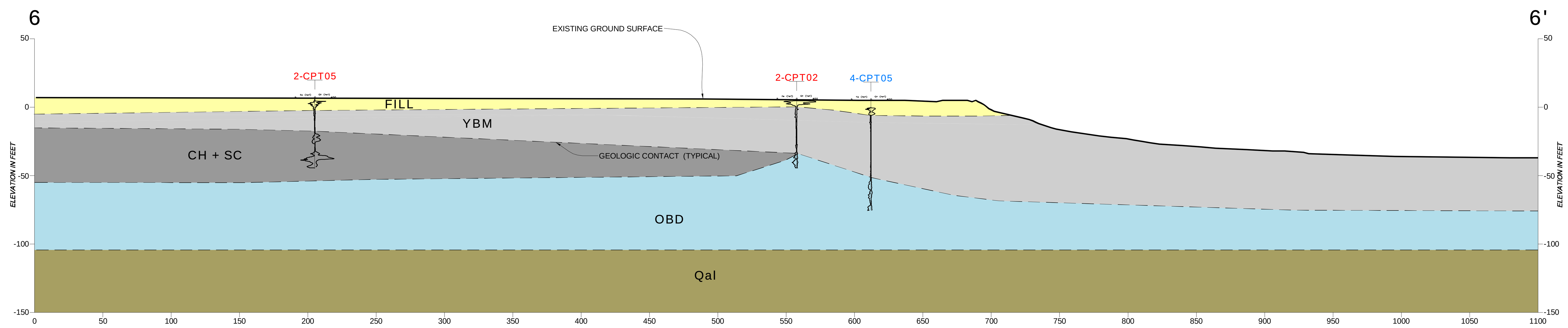
CROSS SECTIONS 1-1' TO 4-4'
ENCINAL TERMINALS
ALAMEDA, CALIFORNIA

PROJECT NO.: 9769.000.000	FIGURE NO. 5A
SCALE: AS SHOWN	
DRAWN BY: GLJ	CHECKED BY: JAF

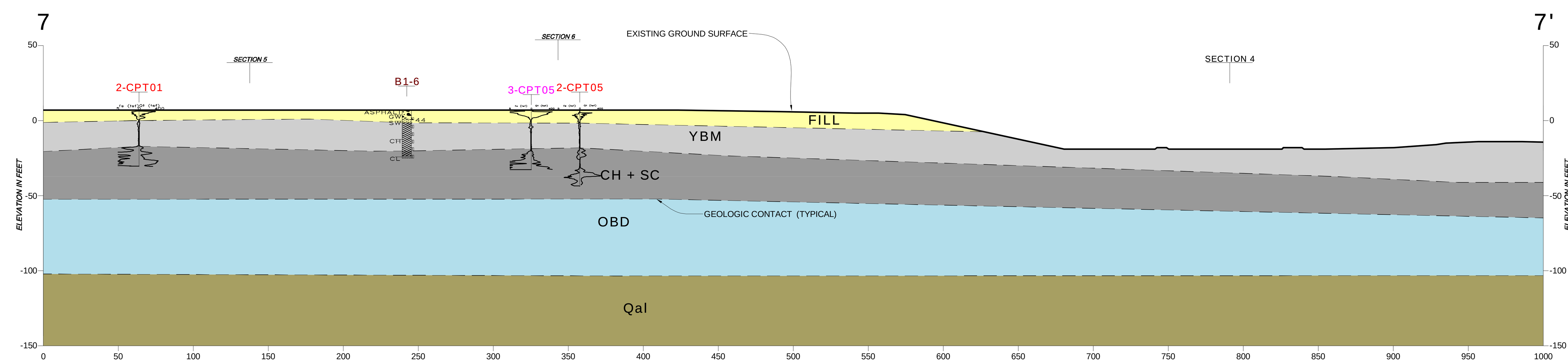
ORIGINAL FIGURE PRINTED IN COLOR



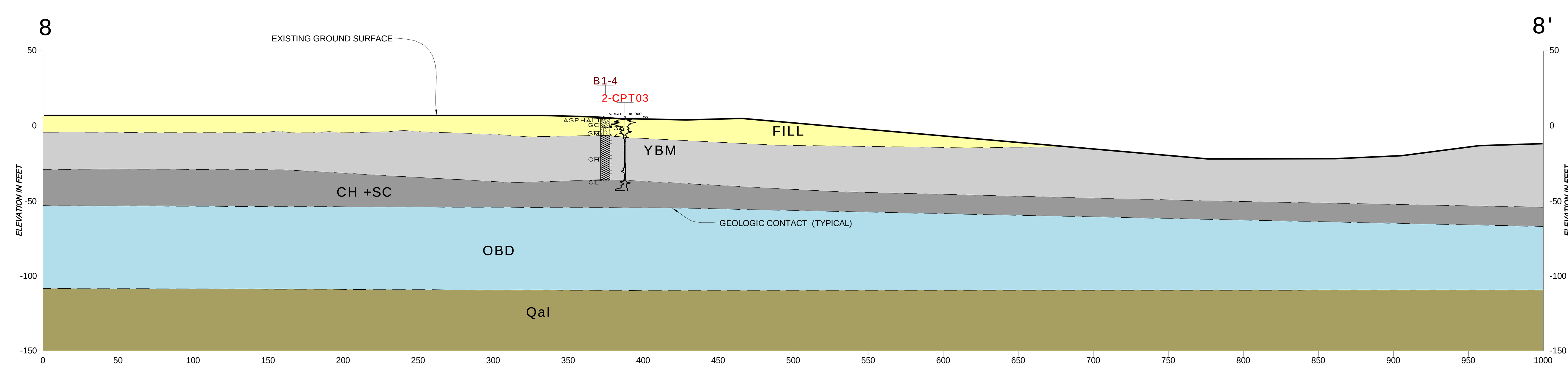
SECTION 5-5'
1"=50'



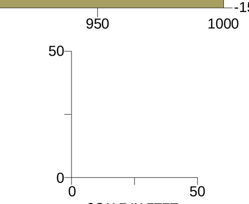
SECTION 6-6'
1"=50'

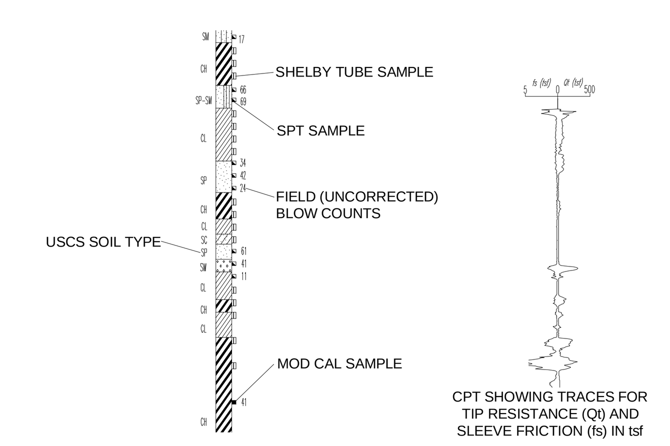


SECTION 7-7'
1"=50'



SECTION 8-8'
1"=50'





EXPLANATION OF BORING AND CPT SYMBOLS

EXPLANATION
ALL LOCATIONS ARE APPROXIMATE

FILL	ARTIFICIAL FILL
YBM	YOUNG BAY MUD (HOLOCENE)
CH + SC	INTERLAYERED ESTUARINE SANDS AND YOUNG BAY MUD (HOLOCENE)
OBD	OLD BAY DEPOSITS (PLEISTOCENE)
Qal	ALLUVIUM (PLEISTOCENE)
4-CPT05	CONE PENETRATION TEST (ENGEO, JULY 2013)
3-CPT05	CONE PENETRATION TEST (ENGEO, JANUARY 2013)
2-CPT05	CONE PENETRATION TEST (ENGEO, NOVEMBER 2012)
B1-6	BORING (ENGEO, JANUARY 2013)
SECTION 8	CROSS SECTION LINE

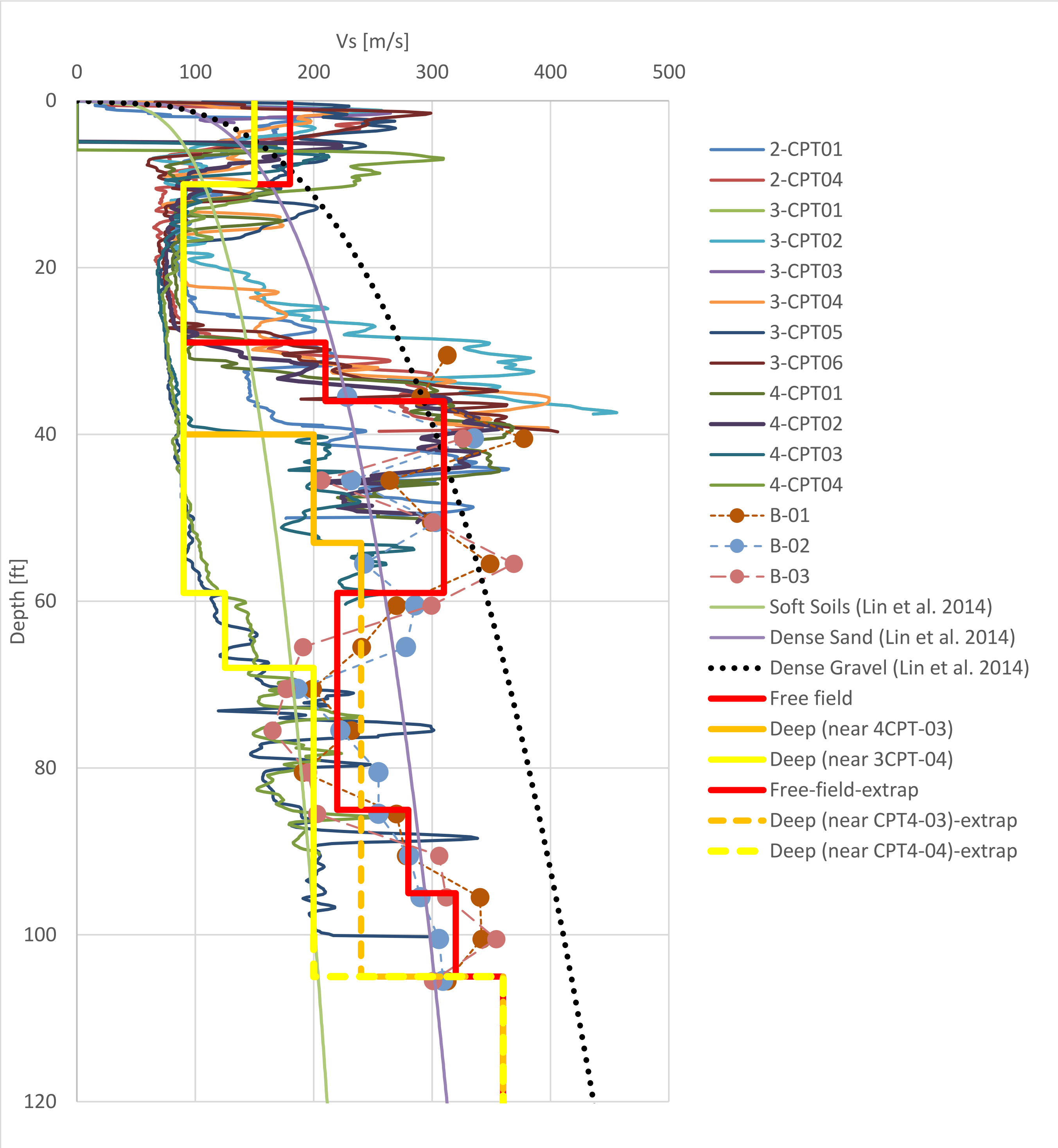
ENGEO Expect Excellence	CROSS SECTIONS 5-5' TO 8-8' ENCINAL TERMINALS ALAMEDA, CALIFORNIA	PROJECT NO.: 9769.000.000	FIGURE NO.
		SCALE: AS SHOWN	5B
		DRAWN BY: GLJ / CHECKED BY: JAF	

ORIGINAL FIGURE PRINTED IN COLOR

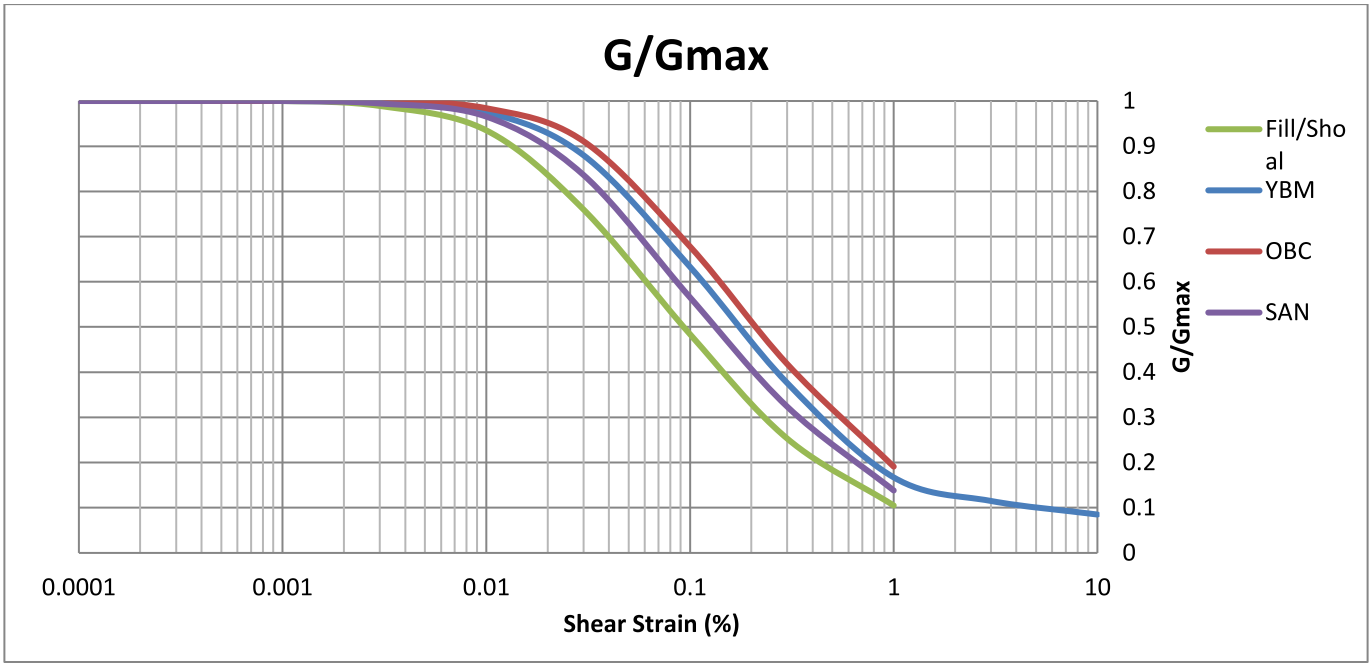
APPENDIX A

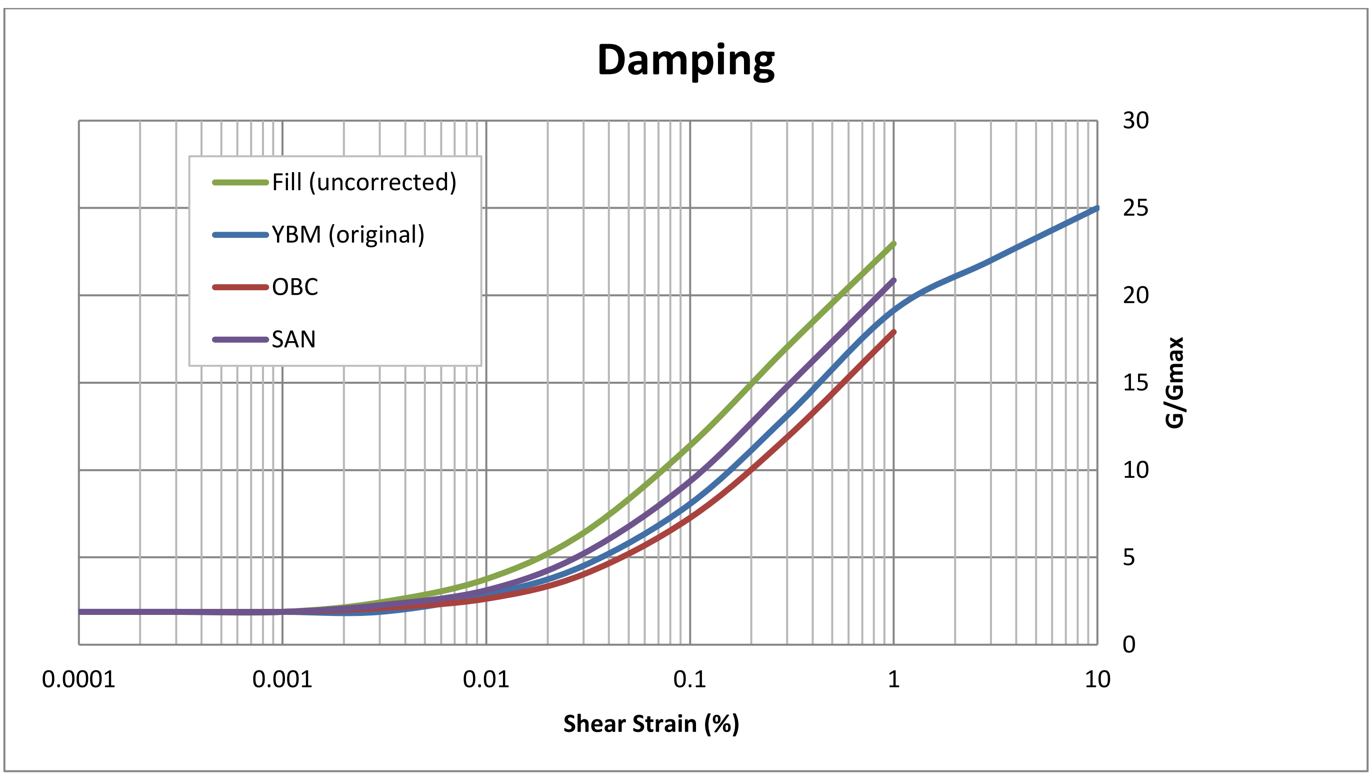
Seed Ground Motions and Dynamic Properties

9769.000.000
October 2, 2017



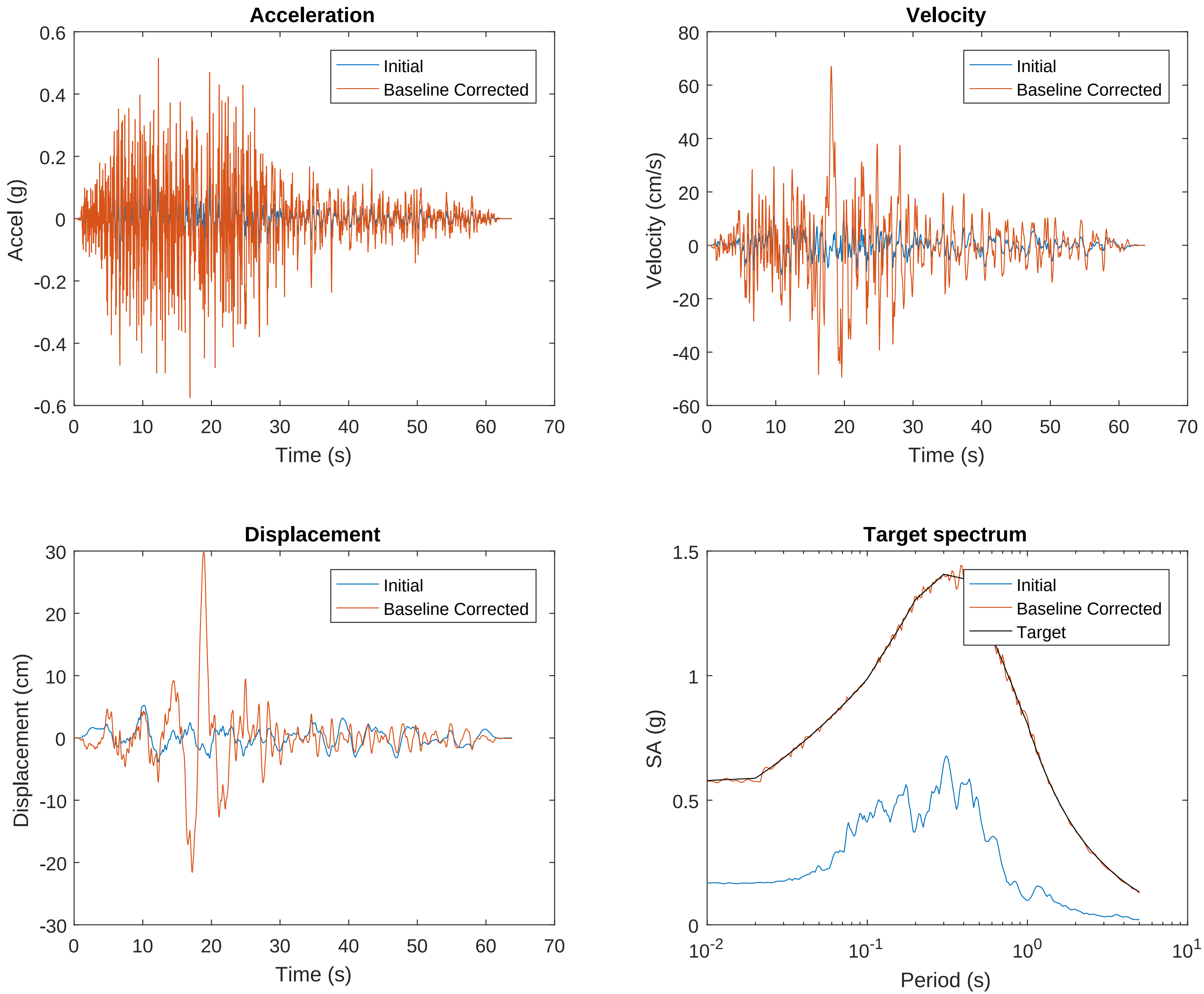
Shear Wave Velocity Profile



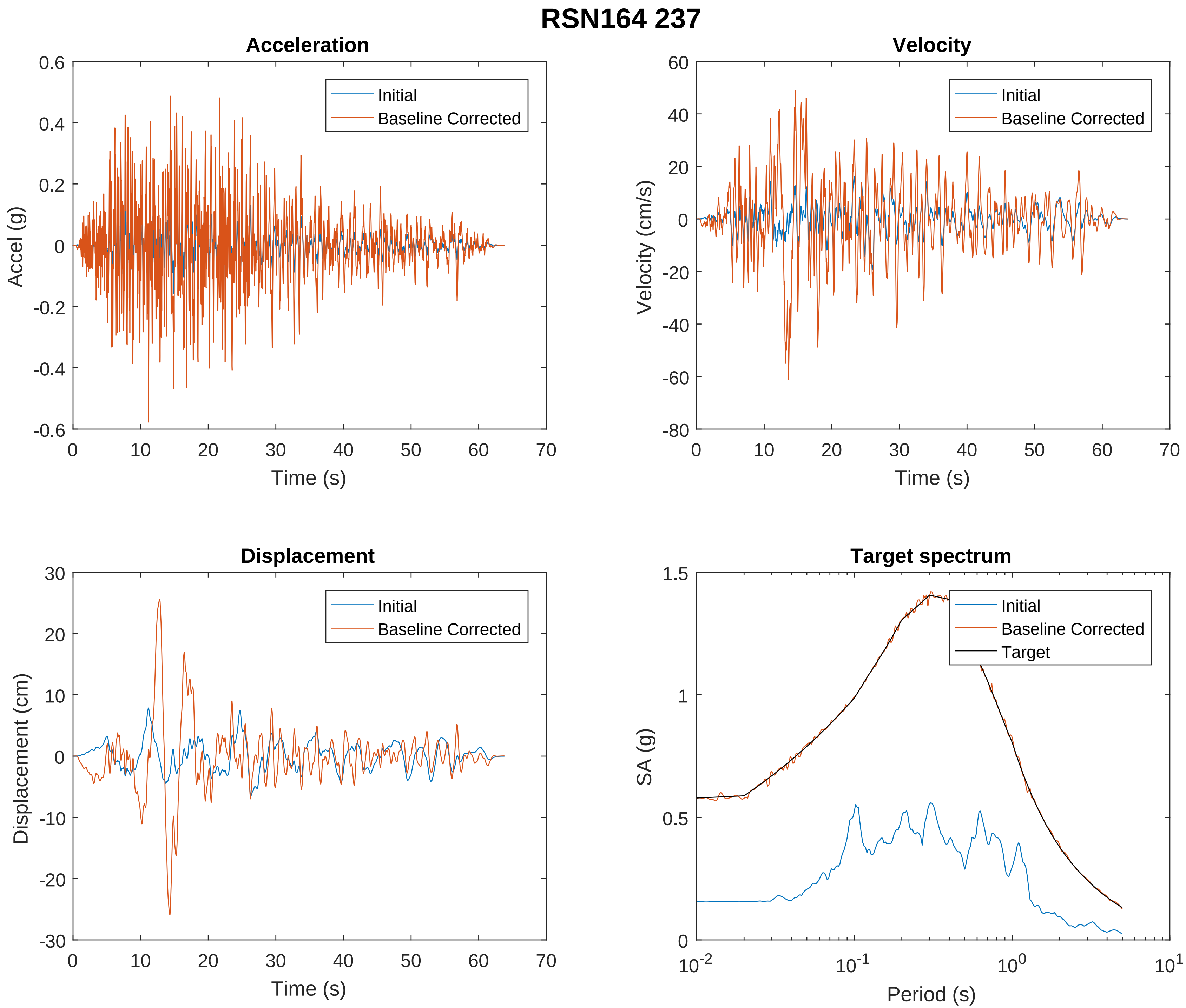


Dynamic Properties

RSN164 147

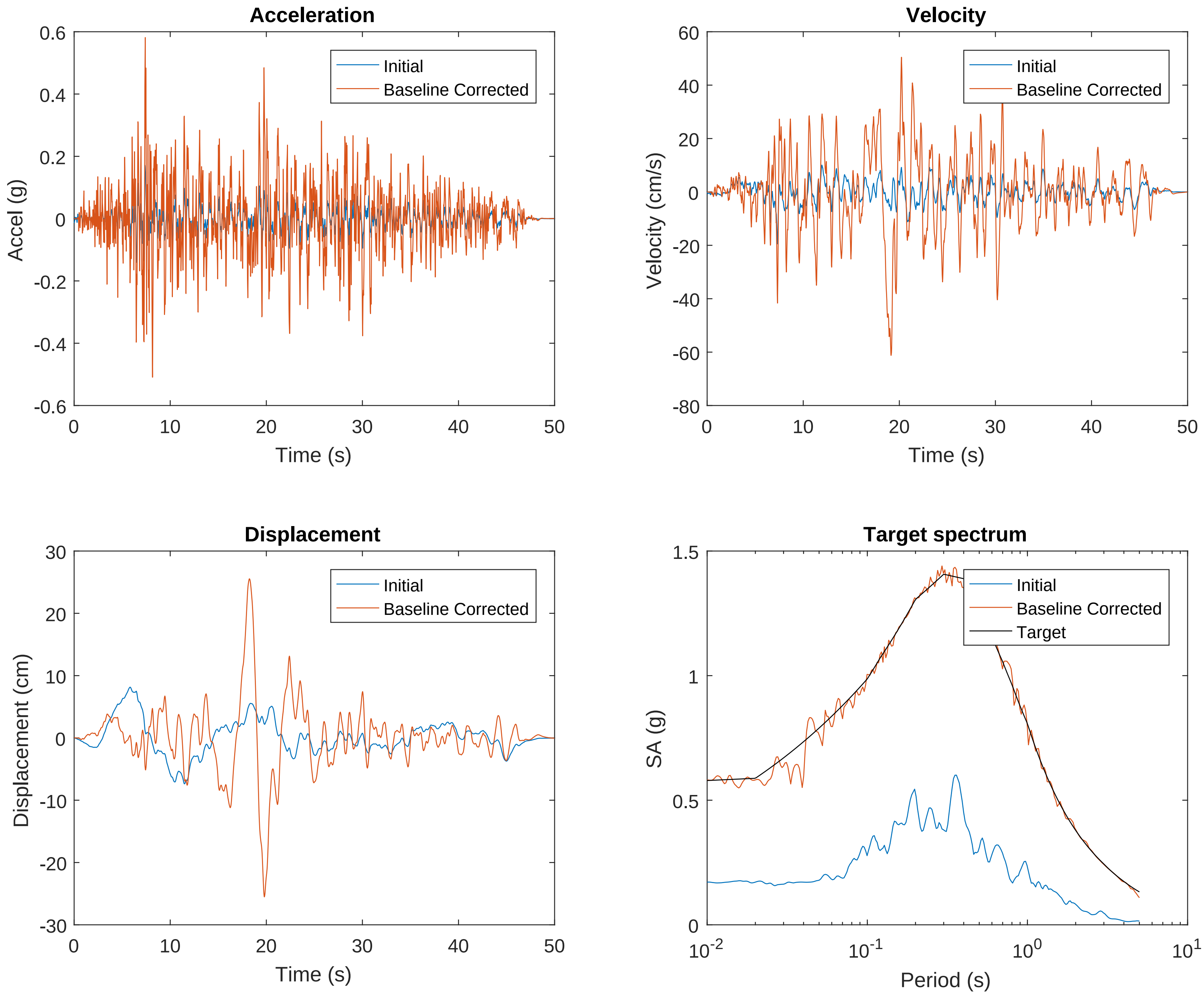


Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
10
20
30
40
50
60
70
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
80
60
40
20
0
-20
-40
-60
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
30
20
10
0
-10
-20
-30
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target
1.5
1
0.5
0
10^{-2}
10^{-1}
10^{0}
10^{1}

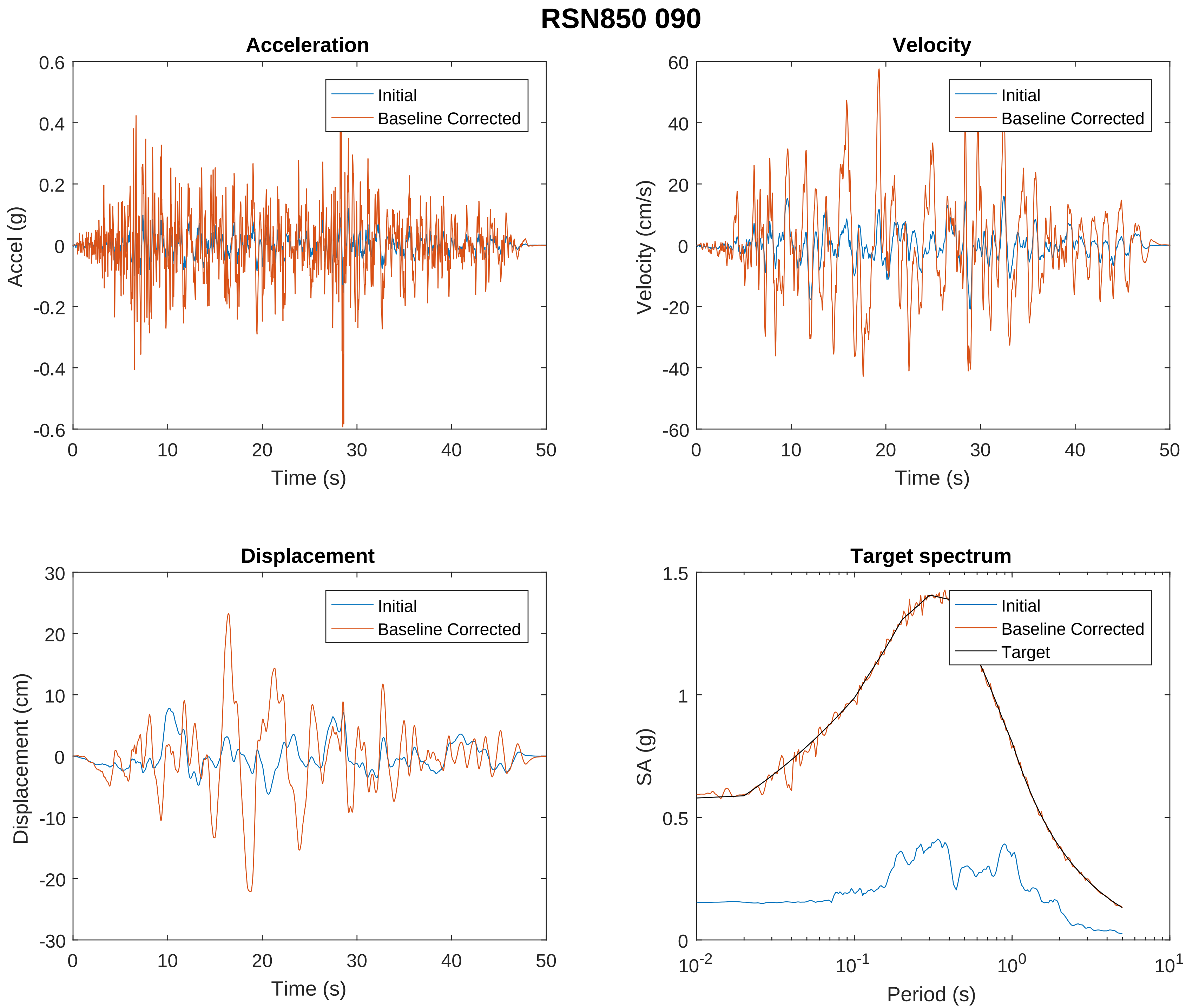


RSN164 237
Acceleration
Initial
Baseline Corrected
Accel (g)
Time (s)
Velocity
Velocity (cm/s)
Displacement
Displacement (cm)
Target spectrum
Target
SA (g)
Period (s)

RSN850 000



Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target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Time (s)
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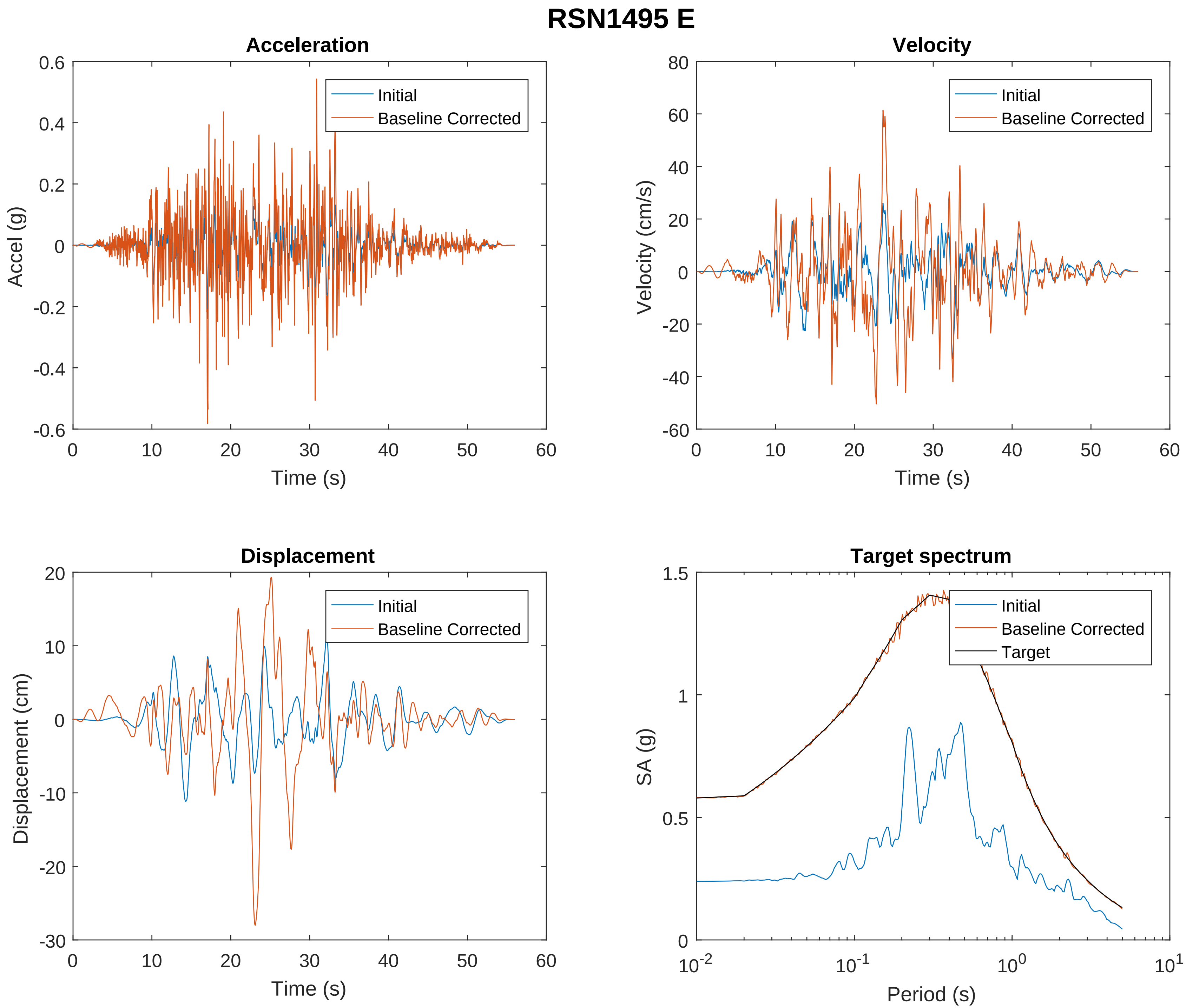
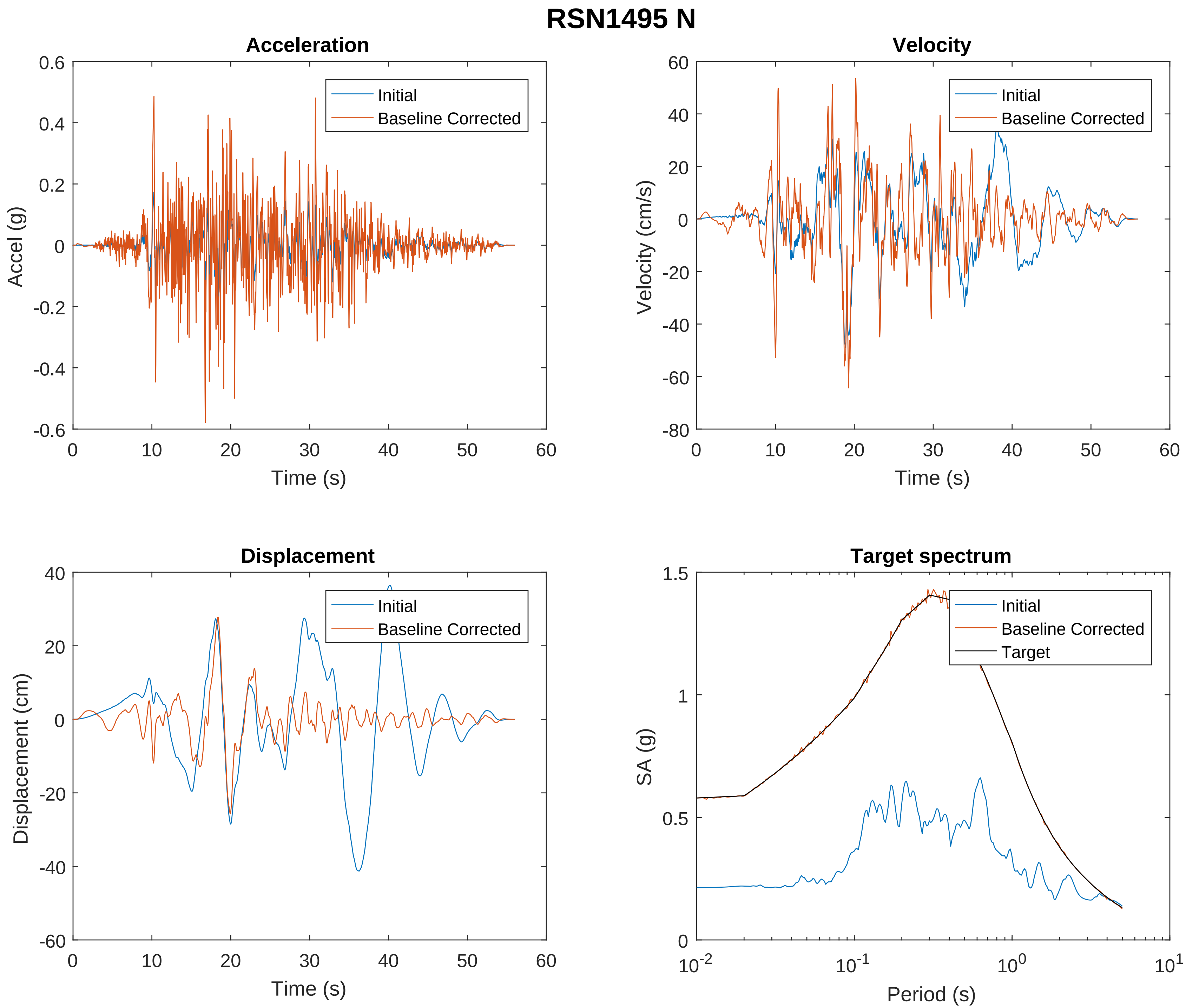
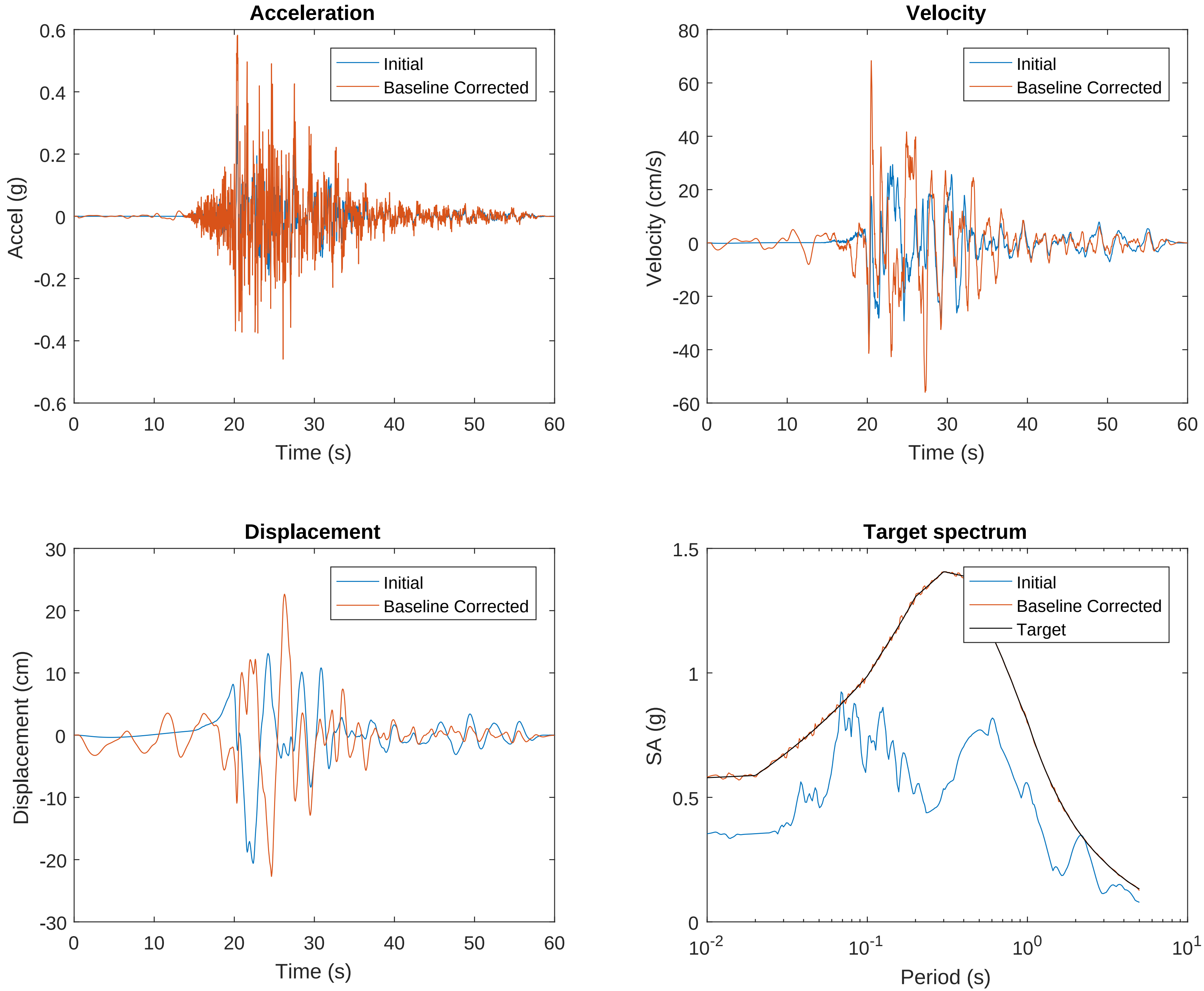
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target

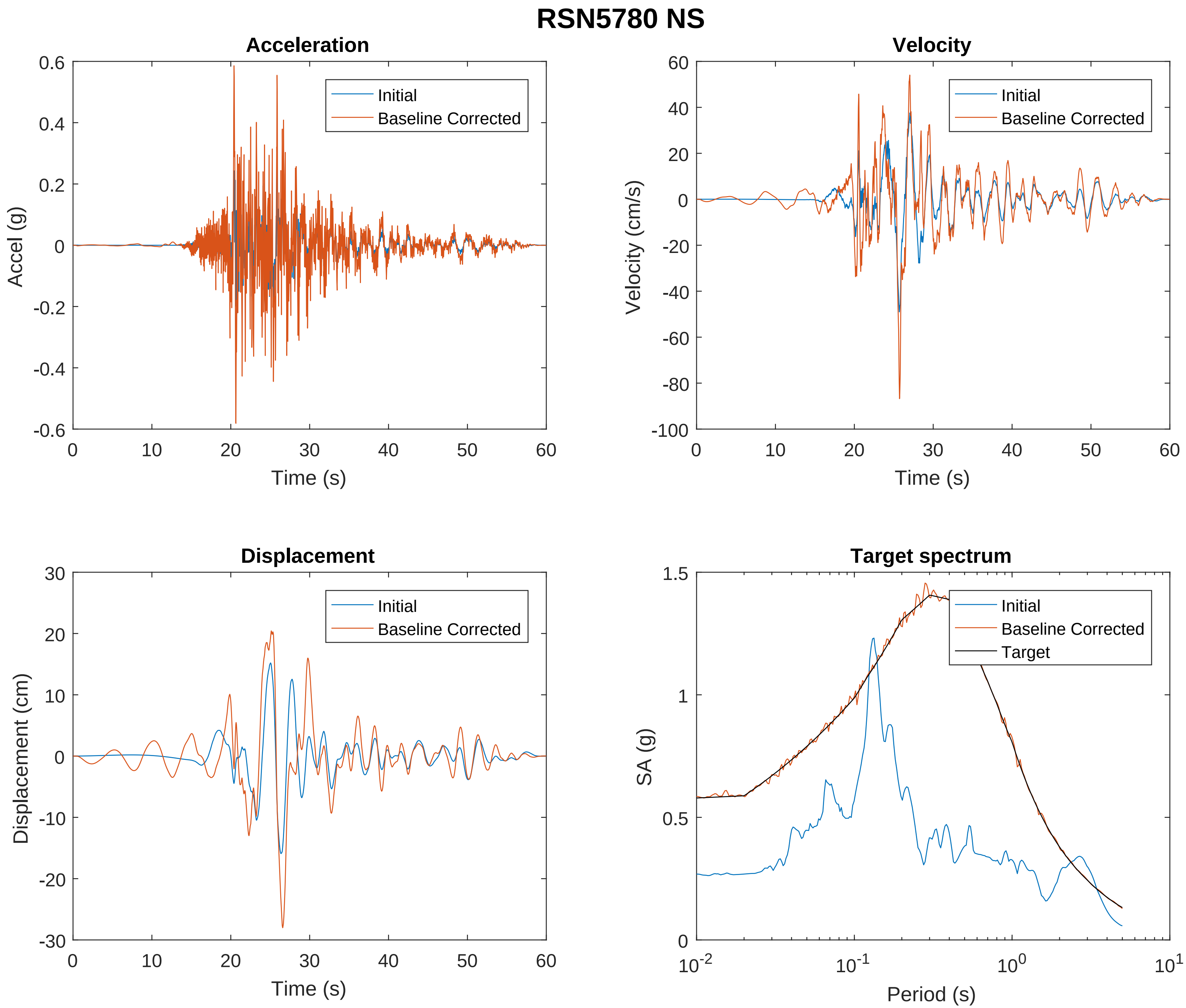

RSN1495 E
Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target


RSN1495 N
Acceleration
Accel (g)
Time (s)
Velocity
Velocity (cm/s)
Time (s)
Displacement
Displacement (cm)
Time (s)
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target

RSN5780 EW



Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target



RSN5780 NS
Acceleration
Accel (g)
Time (s)
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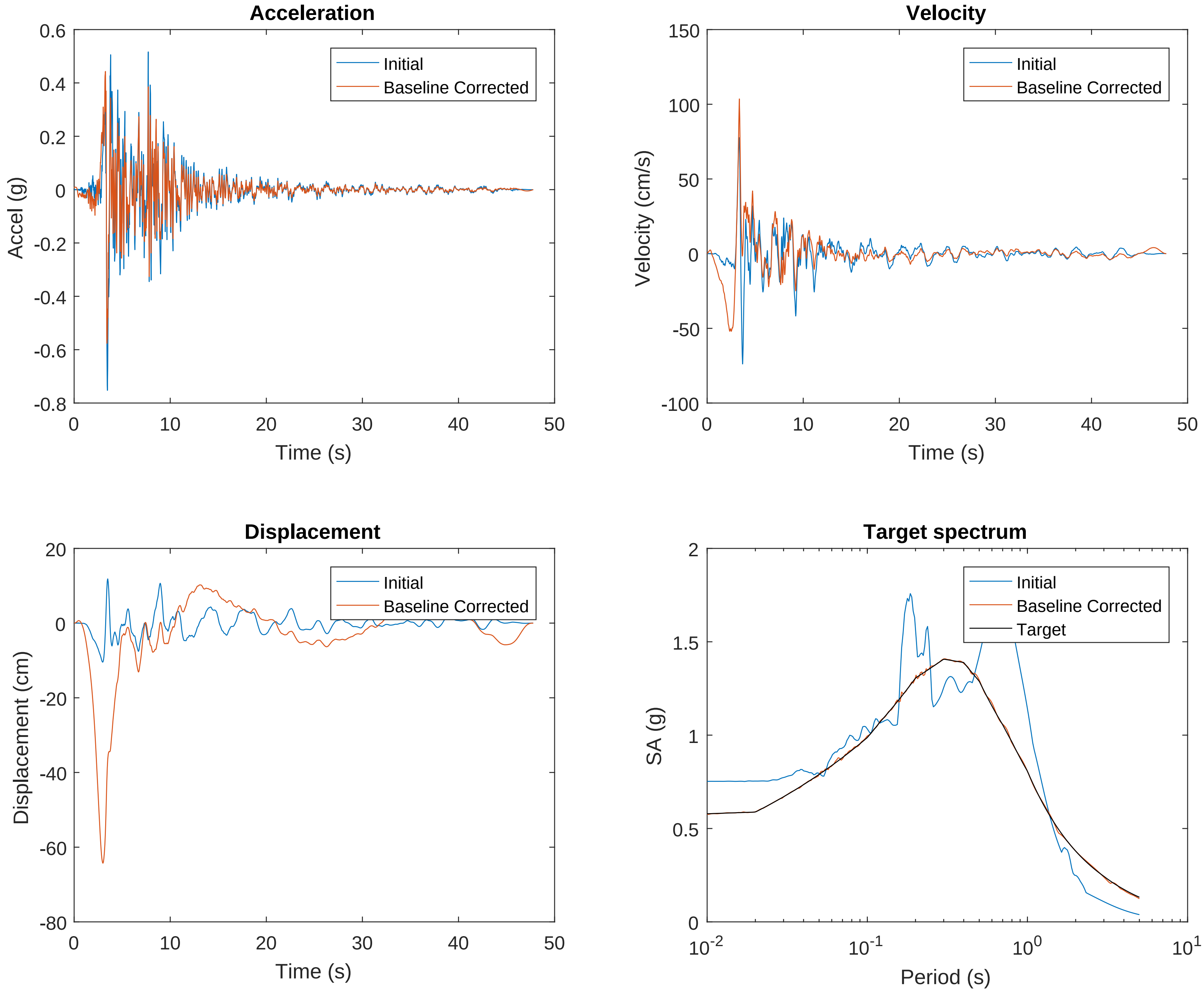
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target

RSN1004 270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Initial
Baseline Corrected
Accel (g)
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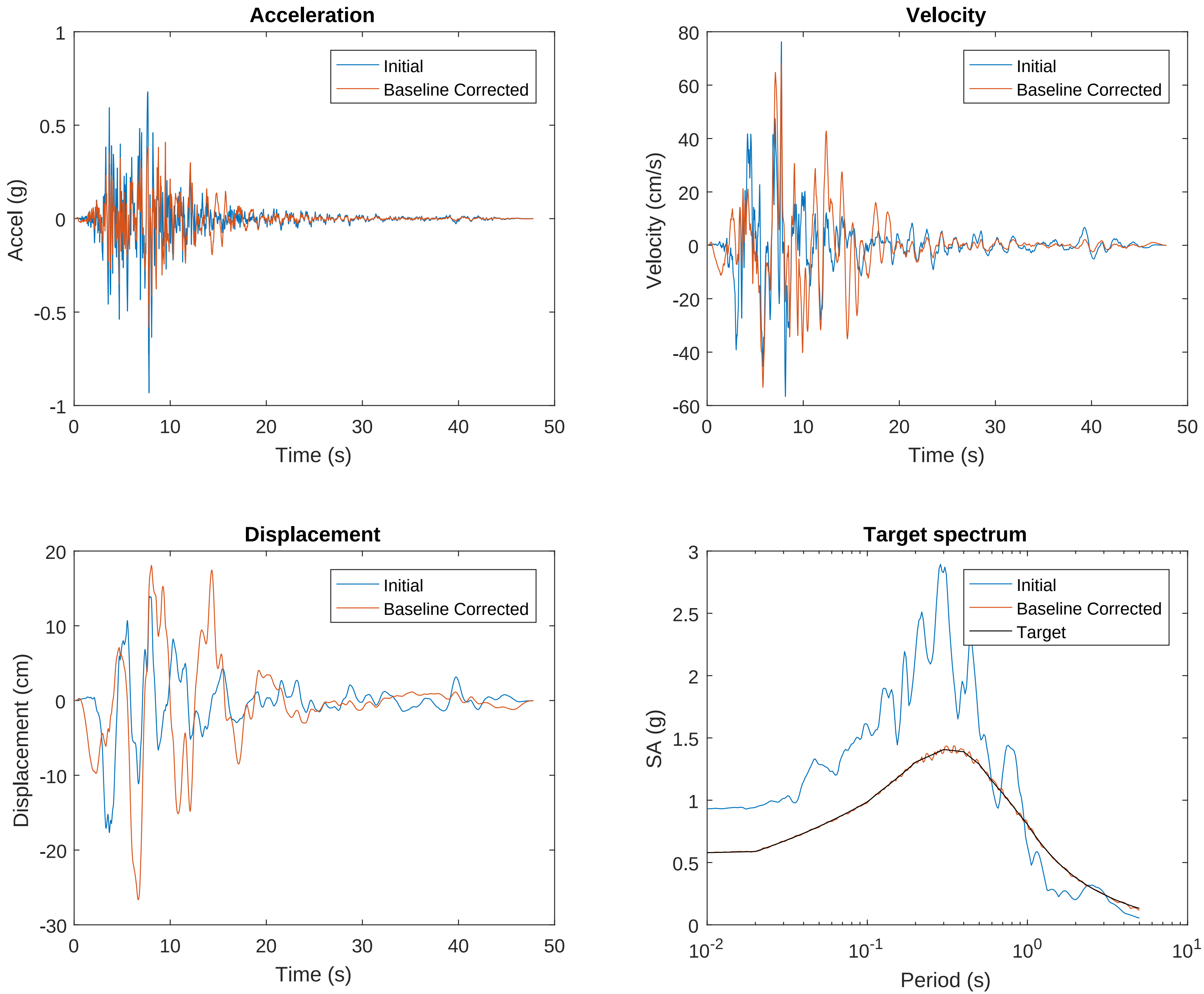
-0.2
-0.4
-0.6
-0.8
0
10
20
30
40
50
Time (s)
Velocity
Initial
Baseline Corrected
Velocity (cm/s)
150
100
50
0
-50
-100
0
10
20
30
40
50
Time (s)
Displacement
Initial
Baseline Corrected
Displacement (cm)
20
0
-20
-40
-60
-80
0
10
20
30
40
50
Time (s)
Target spectrum
Initial
Baseline Corrected
Target
SA (g)
2
1.5
1
0.5
0
10^{-2}
10^{-1}
10^{0}
10^{1}
Period (s)

RSN1004 360



Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
1
0.5
0
-0.5
-1
0
10
20
30
40
50
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
80
60
40
20
0
-20
-40
-60
0
10
20
30
40
50
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
20
10
0
-10
-20
-30
0
10
20
30
40
50
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target
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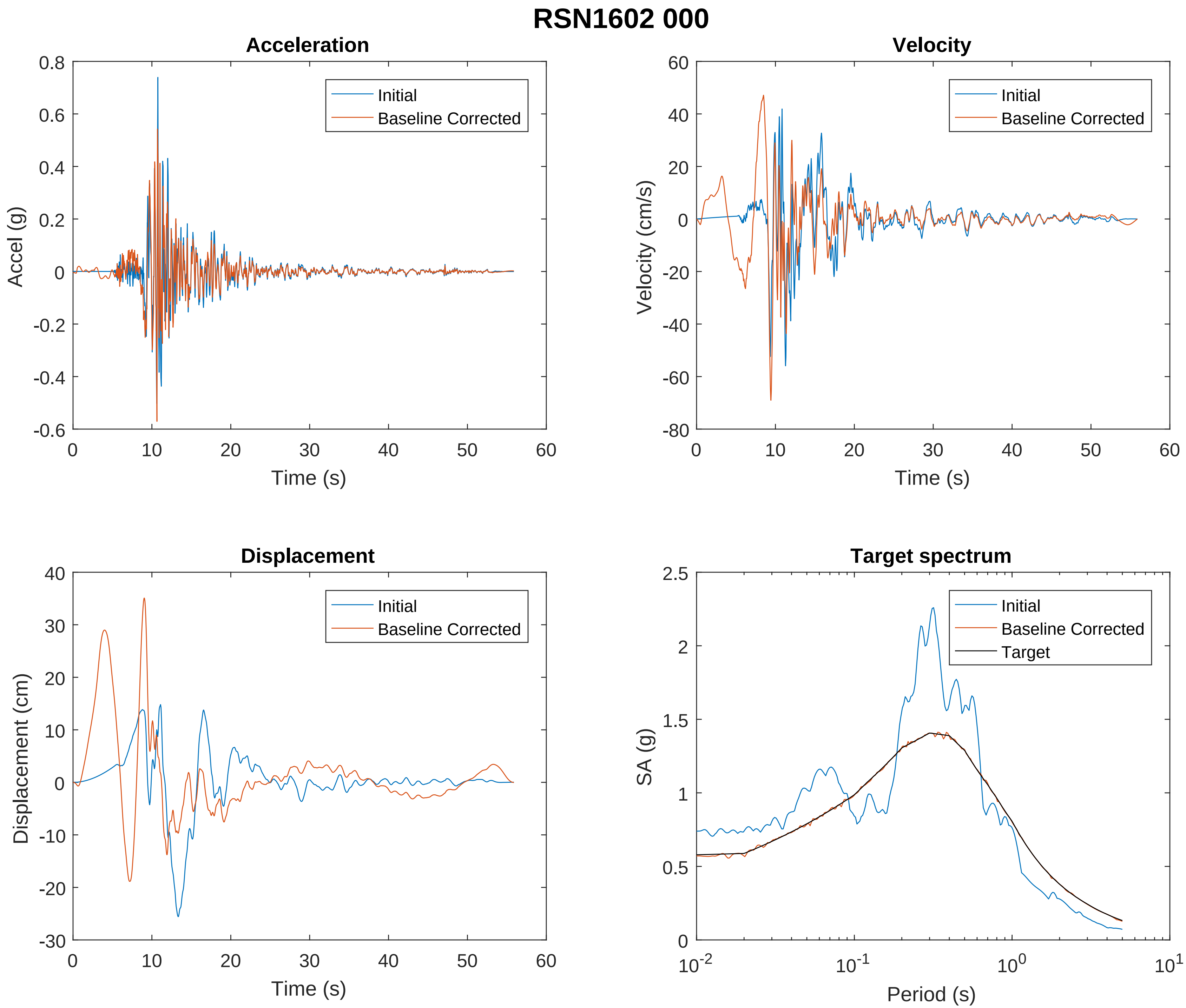
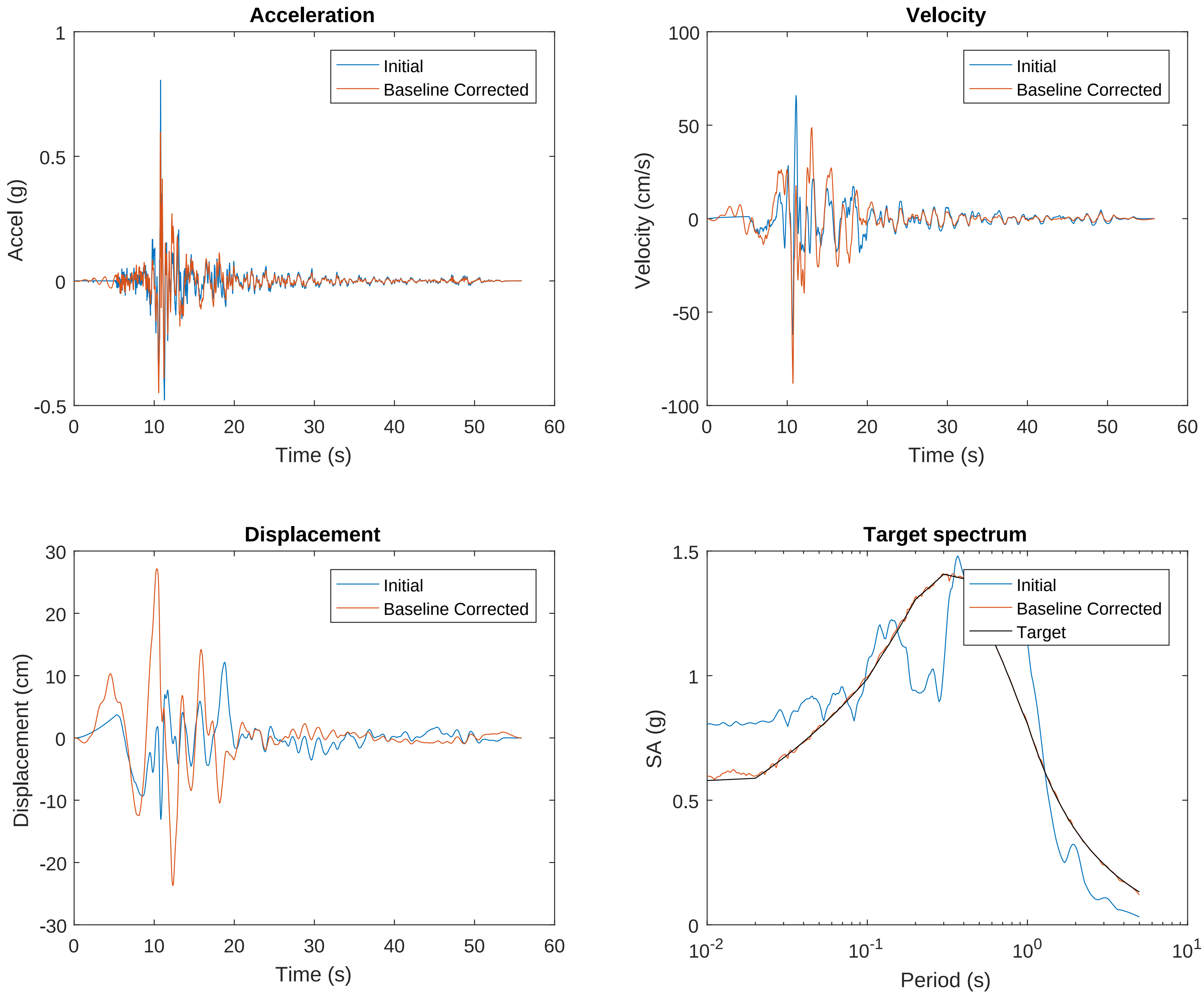
2.5
2
1.5
1
0.5
0
10^-2
10^-1
10^0
10^1


RSN1602 000
Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target

RSN1602 090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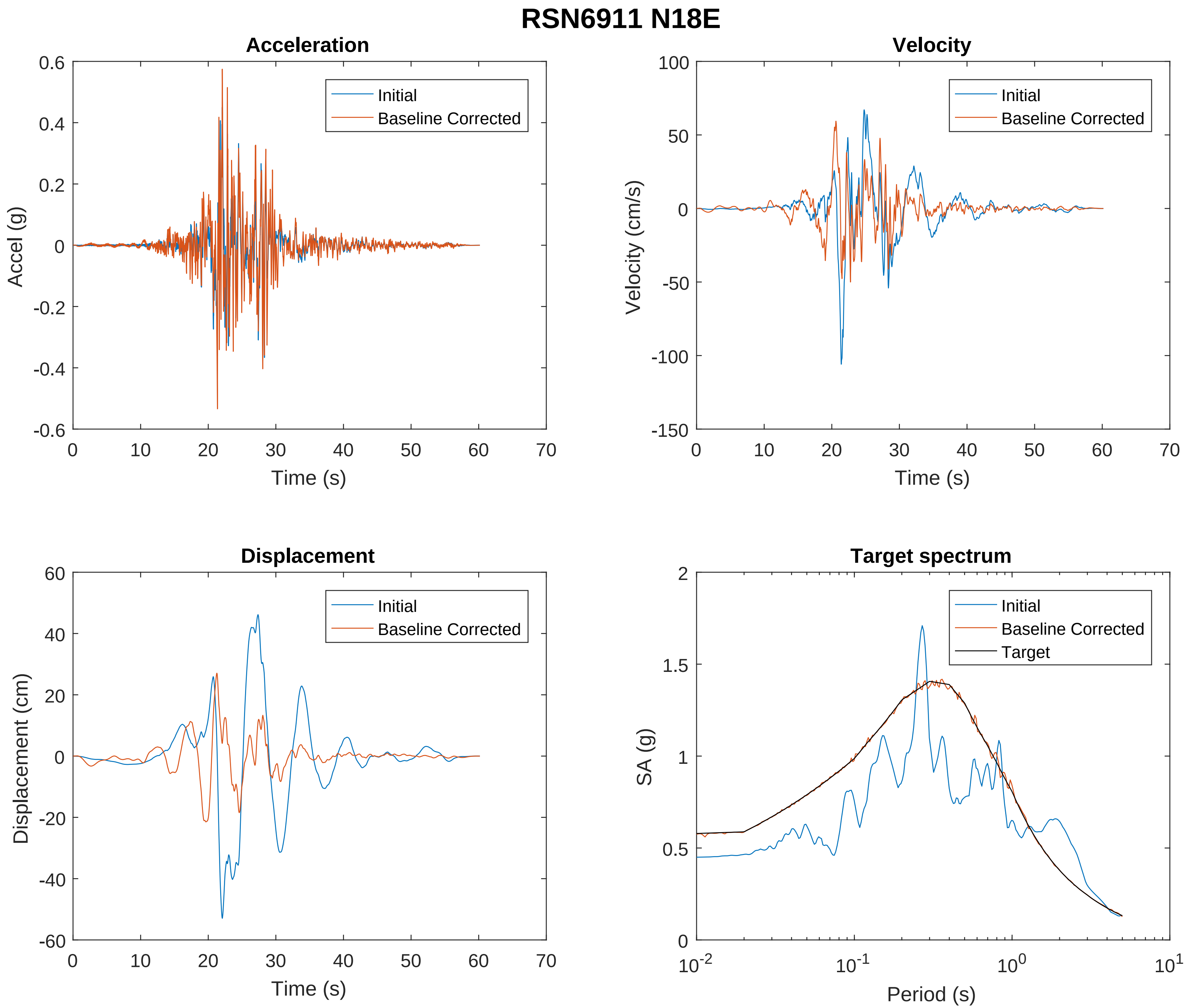
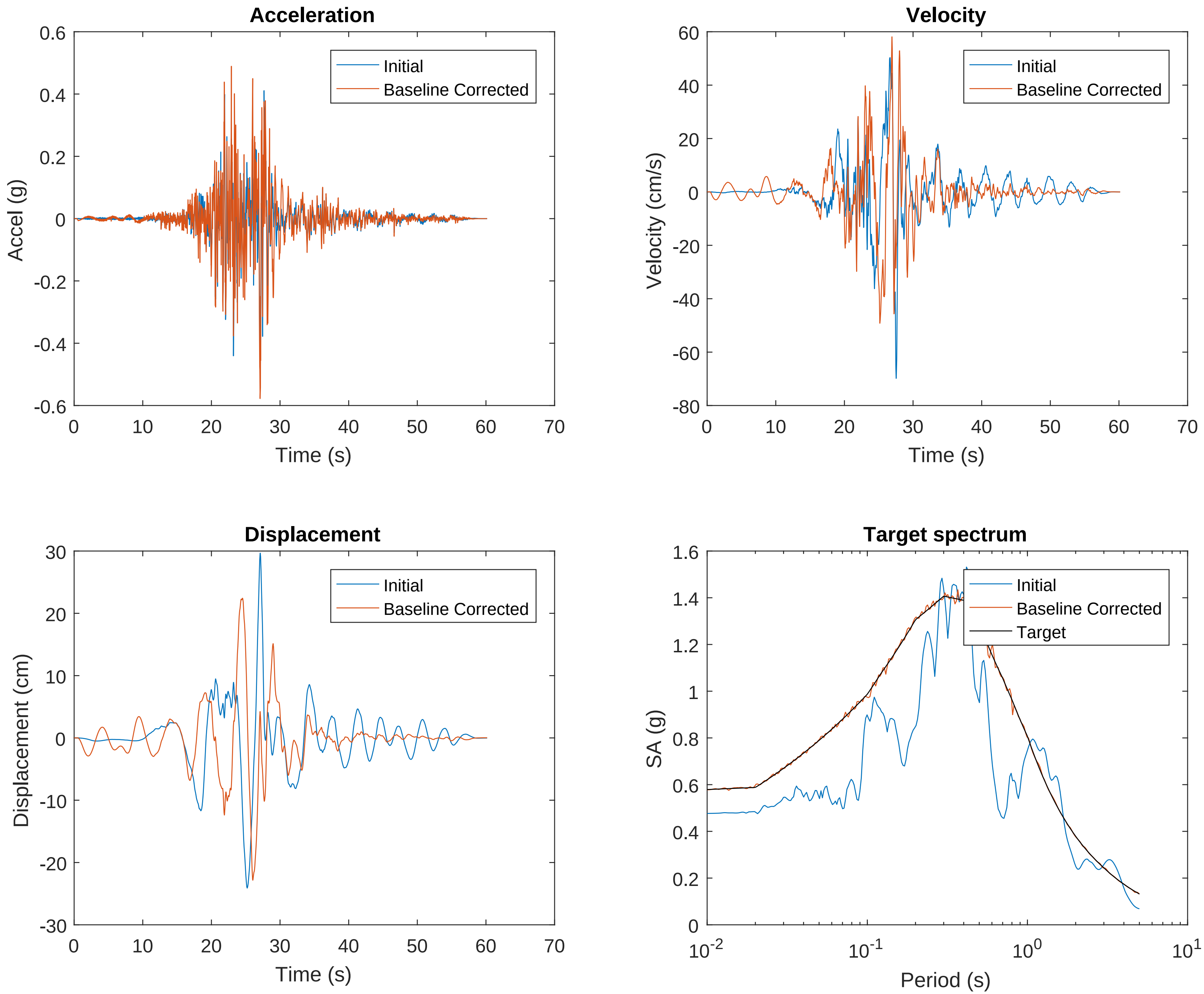
Accel (g)
Time (s)
Initial
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target


RSN6911 N18E
Acceleration
Accel (g)
Time (s)
Initial
Baseline Corrected
Velocity
Velocity (cm/s)
Time (s)
Initial
Baseline Corrected
Displacement
Displacement (cm)
Time (s)
Initial
Baseline Corrected
Target spectrum
SA (g)
Period (s)
Initial
Baseline Corrected
Target

RSN6911 S72E



APPENDIX B

Existing Condition Seismic Slope Stability at Section 8-8

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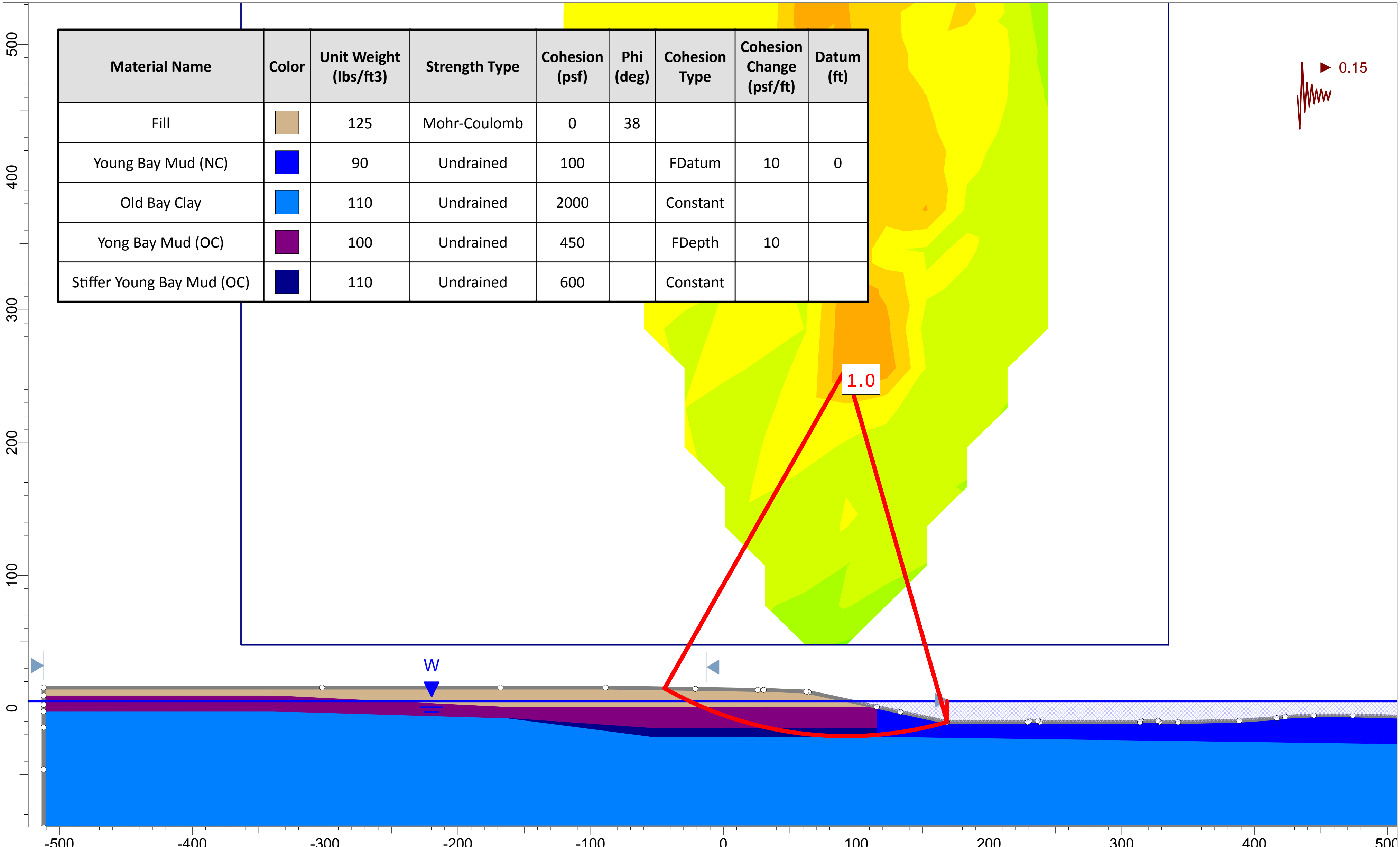
October 2, 2017



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		125	Mohr-Coulomb	0	38			
Young Bay Mud (NC)		90	Undrained	100		FDatum	10	0
Old Bay Clay		110	Undrained	2000		Constant		
Yong Bay Mud (OC)		100	Undrained	450		FDepth	10	
Stiffer Young Bay Mud (OC)		110	Undrained	600		Constant		

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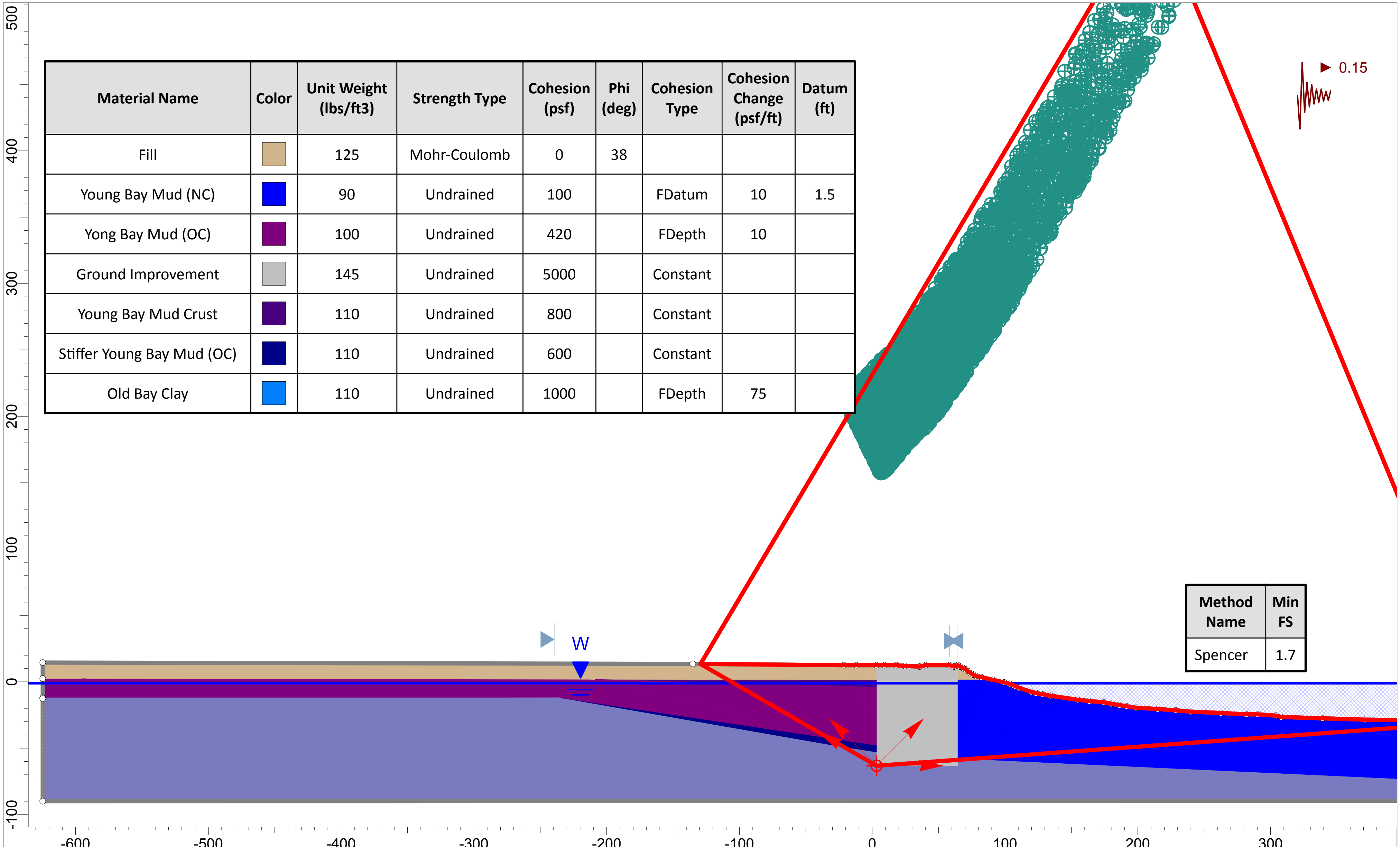
SLIDEINTERPRET 7.023

Project	Cross Section 8, City of Alameda Datum
Analysis Description	Spencer Method
Drawn By	J. Fippin
Company	ENGEO
Date	9/26/2017
File Name	X-section East Shorline Section 8 Pseudo Static.slim

APPENDIX C

Analysis of DSM Buttress Section 6-6

9769.000.000
October 2, 2017



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		125	Mohr-Coulomb	0	38			
Young Bay Mud (NC)		90	Undrained	100		FDatum	10	1.5
Yong Bay Mud (OC)		100	Undrained	420		FDepth	10	
Ground Improvement		145	Undrained	5000		Constant		
Young Bay Mud Crust		110	Undrained	800		Constant		
Stiffer Young Bay Mud (OC)		110	Undrained	600		Constant		
Old Bay Clay		110	Undrained	1000		FDepth	75	

Method Name	Min FS
Spencer	1.7

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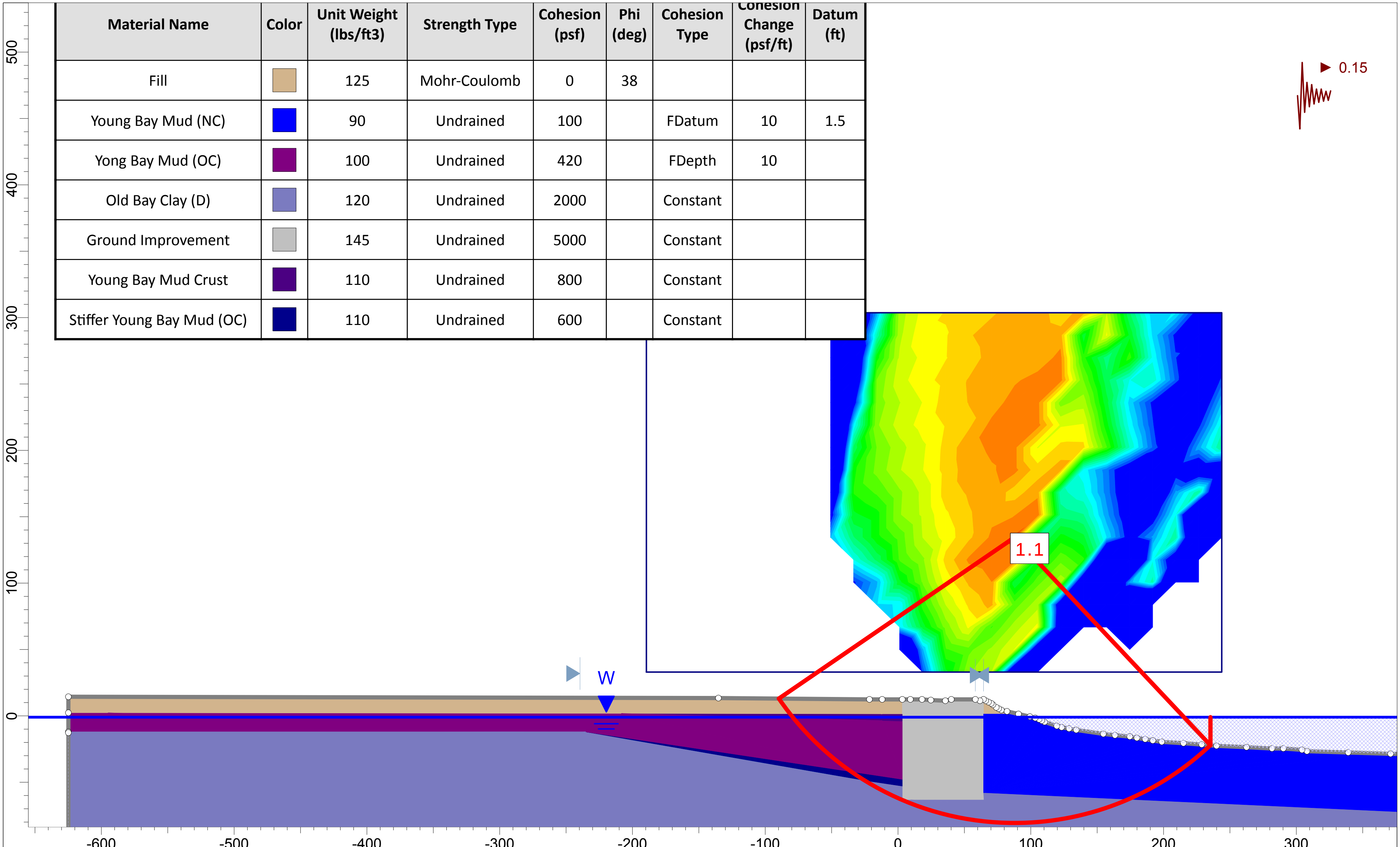
SLIDEINTERPRET 7.023

Project	Cross Section 5, Failure Surface Through DSM Buttress
Analysis Description	Spencer Method
Drawn By	J Fippin
Company	ENGEO
Date	9/26/17
File Name	X-section North Shorline 5' Pseudo Static (GI) (through).slim

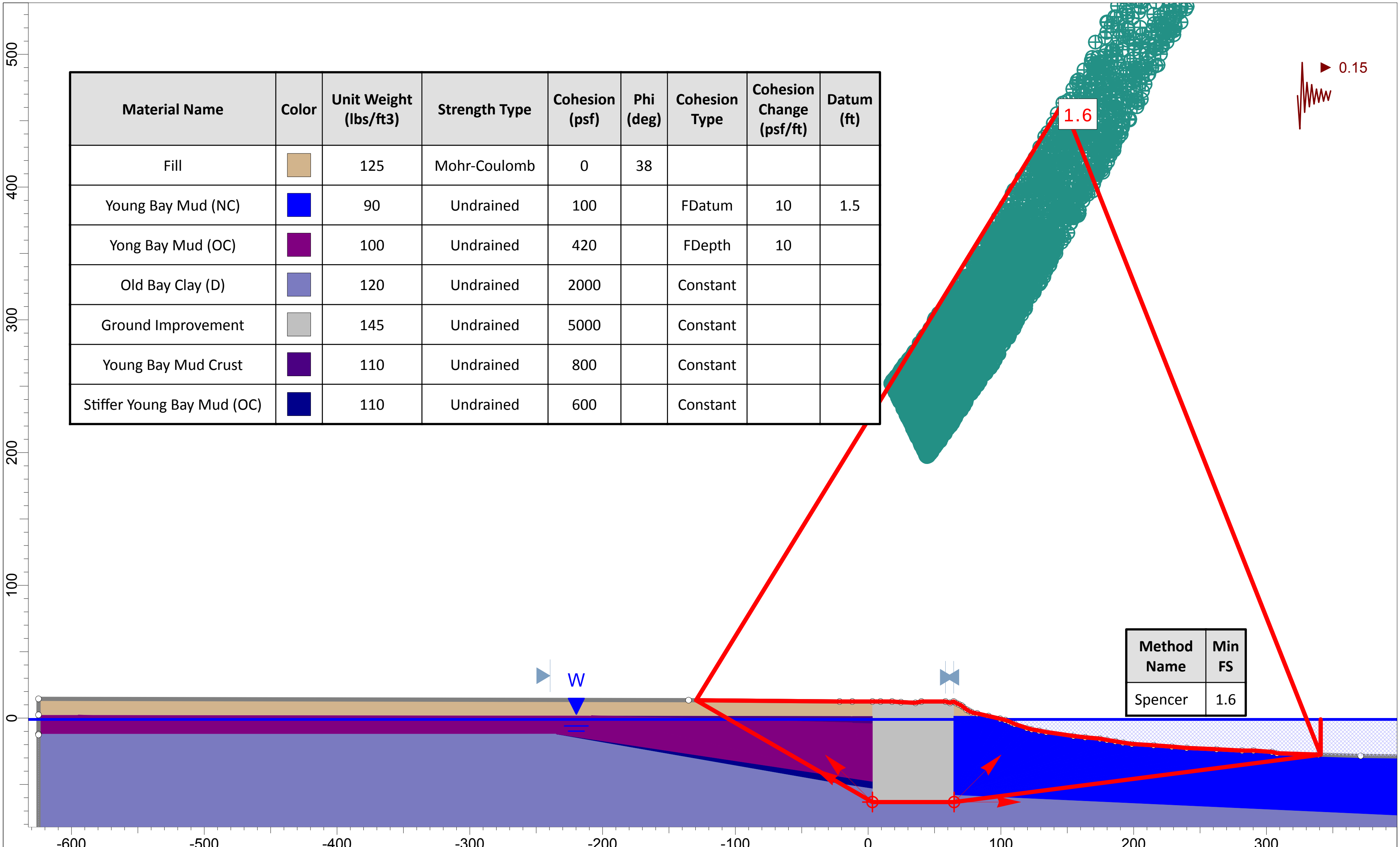
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		125	Mohr-Coulomb	0	38			
Young Bay Mud (NC)		90	Undrained	100		FDatum	10	1.5
Yong Bay Mud (OC)		100	Undrained	420		FDepth	10	
Old Bay Clay (D)		120	Undrained	2000		Constant		
Ground Improvement		145	Undrained	5000		Constant		
Young Bay Mud Crust		110	Undrained	800		Constant		
Stiffer Young Bay Mud (OC)		110	Undrained	600		Constant		



ENGEO
Expect Excellence

SLIDEINTERPRET 7.023

Project	Cross Section 5, Failure Surface Under DSM Buttress Circular
Analysis Description	Spencer Method
Drawn By	J Fippin
Company	ENGEO
Date	9/26/17
File Name	X-section North Shorline 5' Pseudo Static (GI) circle.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Cohesion Change (psf/ft)	Datum (ft)
Fill		125	Mohr-Coulomb	0	38			
Young Bay Mud (NC)		90	Undrained	100		FDatum	10	1.5
Yong Bay Mud (OC)		100	Undrained	420		FDepth	10	
Old Bay Clay (D)		120	Undrained	2000		Constant		
Ground Improvement		145	Undrained	5000		Constant		
Young Bay Mud Crust		110	Undrained	800		Constant		
Stiffer Young Bay Mud (OC)		110	Undrained	600		Constant		

Method Name	Min FS
Spencer	1.6

ENGEO
Expect Excellence

SLIDEINTERPRET 7.023

Project	Cross Section 5, Failure Surface Under DSM Buttress
Analysis Description	Spencer Method
Drawn By	J Fippin
Company	ENGEO
Date	9/26/17
File Name	X-section North Shorline 5 Pseudo Static (GI).slim

Expect Excellence

APPENDIX D

P-Y Springs

9769.000.000
October 2, 2017

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 5+10 & 10+00 Best Estimate

JOB NO. 9769.000.000
MADE BY JAF
DATE 10/2/17

p-y Curves

Soil Type	Cumulative Depth Below Mudline at top of slope (ft)	Elevation (ft)	y1 (in)	p1 (psi)	y2 (in)	p2 (psi)	y3 (in)	p3 (psi)
Clay (YBM)	0	-7.7	1.1	20	5.9	35	7.7	38
	2	-9.7	0.5	25	5.9	59	7.7	63
	4	-11.7	0.5	36	5.9	85	7.7	91
	6	-13.7	0.5	49	5.9	115	7.7	123
	8	-15.7	0.5	63	5.9	147	7.7	158
	10	-17.7	2.8	144	5.9	183	7.7	196
	12	-19.7	2.8	175	5.9	222	7.7	238
	14	-21.7	2.8	200	5.9	254	7.7	272
	16	-23.7	2.8	216	5.9	275	7.7	295
	18	-25.7	2.8	233	5.9	296	7.7	318
	20	-27.6	2.8	249	5.9	316	7.7	339
Clay	20	-27.8	2.3	824	6.0	1,049	9.9	1,124
	22	-29.7	2.3	824	6.0	1,049	9.9	1,124
	24	-31.7	2.3	824	6.0	1,049	9.9	1,124
	26	-33.7	2.3	824	6.0	1,049	9.9	1,124
	30	-37.7	0.3	3,771	0.7	7,025	0.9	7,025
Sand	32	-39.7	0.1	3,194	0.7	8,894	0.9	8,894
	34	-41.7	0.1	3,982	0.7	10,982	0.9	10,982
	36	-43.7	0.1	4,876	0.7	13,289	0.9	13,289
	38	-45.7	0.1	5,886	0.7	15,814	0.9	15,814
	40	-47.7	1.0	2,637	2.7	3,357	4.5	3,596
Clay	42	-49.7	0.7	2,398	2.7	3,357	4.5	3,596
	44	-51.7	1.0	2,637	2.7	3,357	4.5	3,596
Clay	46	-53.7	0.3	26,788	0.5	40,300	0.8	51,397
	48	-55.7	0.2	25,960	0.7	54,531	0.9	54,531
	50	-57.7	0.2	27,708	0.7	57,666	0.9	57,666
	52	-59.7	0.2	29,466	0.7	60,800	0.9	60,800
	54	-61.7	0.2	32,120	0.7	63,935	0.9	63,935
Clay (Shell Layer	56	-63.7	1.0	2,887	2.7	3,674	4.5	3,937

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 5+10 & 10+00 Lower Bound

JOB NO. 9769.000.000
MADE BY JAF
DATE 10/2/17

P multiplier 0.75

p-y Curves									
Soil Type	Cumulative Depth Below Mudline at top of slope (ft)	Elevation (ft)	y1 (in)	p1 (psi)	y2 (in)	p2 (psi)	y3 (in)	p3 (psi)
Clay (YBM)	0	-7.7	1.1	15	5.9	26	7.7	28
	2	-9.7	0.5	19	5.9	44	7.7	47
	4	-11.7	0.5	27	5.9	64	7.7	68
	6	-13.7	0.5	37	5.9	86	7.7	92
	8	-15.7	0.5	47	5.9	111	7.7	118
	10	-17.7	2.8	108	5.9	137	7.7	147
	12	-19.7	2.8	131	5.9	167	7.7	179
	14	-21.7	2.8	150	5.9	191	7.7	204
	16	-23.7	2.8	162	5.9	206	7.7	221
	18	-25.7	2.8	175	5.9	222	7.7	238
	20	-27.6	2.8	186	5.9	237	7.7	254
Clay	20	-27.8	2.3	618	6.0	787	9.9	843
	22	-29.7	2.3	618	6.0	787	9.9	843
	24	-31.7	2.3	618	6.0	787	9.9	843
	26	-33.7	2.3	618	6.0	787	9.9	843
	30	-37.7	0.3	2,828	0.7	5,269	0.9	5,269
Sand	32	-39.7	0.1	2,396	0.7	6,670	0.9	6,670
	34	-41.7	0.1	2,986	0.7	8,236	0.9	8,236
	36	-43.7	0.1	3,657	0.7	9,966	0.9	9,966
	38	-45.7	0.1	4,415	0.7	11,861	0.9	11,861
	40	-47.7	1.0	1,978	2.7	2,517	4.5	2,697
Clay	42	-49.7	0.7	1,798	2.7	2,517	4.5	2,697
	44	-51.7	1.0	1,978	2.7	2,517	4.5	2,697
Clay	46	-53.7	0.3	20,091	0.5	30,225	0.8	38,548
	48	-55.7	0.2	19,470	0.7	40,898	0.9	40,898
	50	-57.7	0.2	20,781	0.7	43,249	0.9	43,249
	52	-59.7	0.2	22,100	0.7	45,600	0.9	45,600
	54	-61.7	0.2	24,090	0.7	47,951	0.9	47,951
Clay (Shell Layer	56	-63.7	1.0	2,165	2.7	2,756	4.5	2,952

PROJECT Encinal Terminals | JOB NO. 9769.000.000
SUBJECT C1 Timber Piles | MADE BY JAF | P multiplier 1.5
STATION 5+10 & 10+00 Upper Bound | DATE 10/2/17

p-y Curves									
Soil Type	Cumulative Depth Below Mudline at top of slope (ft)	Elevation (ft)	y1 (in)	p1 (psi)	y2 (in)	p2 (psi)	y3 (in)	p3 (psi)
Clay (YBM)	0	-7.7	1.1	15.1	5.9	26.5	7.7	28.4
	2	-9.7	0.5	18.8	5.9	43.9	7.7	47.1
	4	-11.7	0.5	27.3	5.9	63.8	7.7	68.3
	6	-13.7	0.5	36.8	5.9	86.0	7.7	92.1
	8	-15.7	0.5	47.4	5.9	110.5	7.7	118.4
	10	-17.7	2.8	108.0	5.9	137.4	7.7	147.2
	12	-19.7	2.8	131.0	5.9	166.7	7.7	178.6
	14	-21.7	2.8	149.7	5.9	190.5	7.7	204.1
	16	-23.7	2.8	162.2	5.9	206.4	7.7	221.1
	18	-25.7	2.8	174.6	5.9	222.3	7.7	238.1
	20	-27.6	2.8	186.5	5.9	237.3	7.7	254.3
Clay	20	-27.8	2.3	618.4	6.0	787.0	9.9	843.2
	22	-29.7	2.3	618.4	6.0	787.0	9.9	843.2
	24	-31.7	2.3	618.4	6.0	787.0	9.9	843.2
	26	-33.7	2.3	618.4	6.0	787.0	9.9	843.2
	30	-37.7	0.3	2828.2	0.7	5268.6	0.9	5268.6
Sand	32	-39.7	0.1	2395.9	0.7	6670.4	0.9	6670.4
	34	-41.7	0.1	2986.4	0.7	8236.4	0.9	8236.4
	36	-43.7	0.1	3656.8	0.7	9966.5	0.9	9966.5
	38	-45.7	0.1	4414.8	0.7	11860.7	0.9	11860.7
	40	-47.7	1.0	1978.0	2.7	2517.5	4.5	2697.3
Clay	42	-49.7	0.7	1798.2	2.7	2517.5	4.5	2697.3
	44	-51.7	1.0	1978.0	2.7	2517.5	4.5	2697.3
Clay	46	-53.7	0.3	20091.3	0.5	30224.8	0.8	38547.6
	48	-55.7	0.2	19469.8	0.7	40898.4	0.9	40898.4
	50	-57.7	0.2	20780.6	0.7	43249.2	0.9	43249.2
	52	-59.7	0.2	22099.8	0.7	45600.1	0.9	45600.1
	54	-61.7	0.2	24089.8	0.7	47950.9	0.9	47950.9
Clay (Shell Layer	56	-63.7	1.0	2165.1	2.7	2755.6	4.5	2952.5

Encinal Terminals - p-y Curves at Station 14+00

Section	Section 14+00						Nominal						
Material	Depth Below Mudline(feet)	p0 (psi)	y0 (in)	p1 (psi)	y1 (in)	p2 (psi)	y2 (in)	p3 (psi)	y3 (in)	p4 (psi)	y4 (in)	p5 (psi)	y5 (in)
Fill	0.5	0	0	24.0751	0.10678	37.45176	0.4875	42.93587	0.675	42.93587	0.81	42.93587	8
Fill	2.5	0	0	136.8909	0.10967	224.6803	0.4875	261.5603	0.675	261.5603	0.81	261.5603	8
Fill	4.9	0	0	216.6521	0.12162	404.9353	0.4875	490.6163	0.675	490.6163	0.81	490.6163	8
YBM	5.1	0	0	60.72	1.09227	83.49	2.83947	98.67	4.68693	106.26	5.85387	113.85	7.2
YBM	25	0	0	204	1.09227	280.5	2.83947	331.5	4.68693	357	5.85387	382.5	7.2
YBM	49.9	0	0	383.28	0.54613	527.01	1.41973	622.83	2.34347	670.74	2.92693	718.65	3.6
OBC	50.1	0	0	1050	0.17074	1500	0.71111	1800	1.47456	1950	2.031	2100	2.7318
OBC	55	0	0	1050	0.17074	1500	0.71111	1800	1.47456	1950	2.031	2250	3.6
OBC	60	0	0	1050	0.17074	1500	0.71111	1800	1.47456	1950	2.031	2250	3.6

Section	Section 14+00						Upper Bound						
Material	Depth Below Mudline(feet)	p0 (psi)	y0 (in)	p1 (psi)	y1 (in)	p2 (psi)	y2 (in)	p3 (psi)	y3 (in)	p4 (psi)	y4 (in)	p5 (psi)	y5 (in)
Fill	0.5	0	0	36.11265	0.10678	56.17764	0.4875	64.40381	0.675	64.40381	0.81	64.40381	8
Fill	2.5	0	0	205.3363	0.10967	337.0204	0.4875	392.3404	0.675	392.3404	0.81	392.3404	8
Fill	4.9	0	0	324.9782	0.12162	607.4029	0.4875	735.9245	0.675	735.9245	0.81	735.9245	8
YBM	5.1	0	0	91.08	1.09227	125.235	2.83947	148.005	4.68693	159.39	5.85387	170.775	7.2
YBM	25	0	0	306	1.09227	420.75	2.83947	497.25	4.68693	535.5	5.85387	573.75	7.2
YBM	49.9	0	0	574.92	0.54613	790.515	1.41973	934.245	2.34347	1006.11	2.92693	1077.975	3.6
OBC	50.1	0	0	1575	0.17074	2250	0.71111	2700	1.47456	2925	2.031	3150	2.7318
OBC	55	0	0	1575	0.17074	2250	0.71111	2700	1.47456	2925	2.031	3375	3.6
OBC	60	0	0	1575	0.17074	2250	0.71111	2700	1.47456	2925	2.031	3375	3.6

Section	Section						Lower Bound						
Material	Depth Below Mudline(feet)	p0 (psi)	y0 (in)	p1 (psi)	y1 (in)	p2 (psi)	y2 (in)	p3 (psi)	y3 (in)	p4 (psi)	y4 (in)	p5 (psi)	y5 (in)
Fill	0.5	0	0	18.05633	0.10678	28.08882	0.4875	32.2019	0.675	32.2019	0.81	32.2019	8
Fill	2.5	0	0	102.6682	0.10967	168.5102	0.4875	196.1702	0.675	196.1702	0.81	196.1702	8
Fill	4.9	0	0	162.4891	0.12162	303.7015	0.4875	367.9622	0.675	367.9622	0.81	367.9622	8
YBM	5.1	0	0	45.54	1.09227	62.6175	2.83947	74.0025	4.68693	79.695	5.85387	85.3875	7.2
YBM	25	0	0	153	1.09227	210.375	2.83947	248.625	4.68693	267.75	5.85387	286.875	7.2
YBM	49.9	0	0	287.46	0.54613	395.2575	1.41973	467.1225	2.34347	503.055	2.92693	538.9875	3.6
OBC	50.1	0	0	787.5	0.17074	1125	0.71111	1350	1.47456	1462.5	2.031	1575	2.7318
OBC	55	0	0	787.5	0.17074	1125	0.71111	1350	1.47456	1462.5	2.031	1687.5	3.6
OBC	60	0	0	787.5	0.17074	1125	0.71111	1350	1.47456	1462.5	2.031	1687.5	3.6

APPENDIX E

Axial Capacities

9769.000.000
October 2, 2017

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles

JOB NO. 9769.000.000
MADE BY SOS
DATE 4/10/13

Best Estimate

q-w Curves										
Station	Soil Type	Upper/ Lower	Cumulative Depth Below Mudline (ft)	Elevation (ft)	q1 (kip)	w1 (in)	q2 (kip)	w2 (in)	q2 (kip)	w3 (in)
1+10 to 10+00	Sand	Lower	45 to 55	-35 to -45	99.6	0.2	199.3	1.8	199.3	3.6
		Upper	45 to 55	-35 to -45	104.6	0.2	209.2	1.8	209.2	3.6
	Clay	Lower	55 to 65	-45 to -55	19.2	0.2	38.4	1.8	38.4	3.6
		Upper	55 to 65	-45 to -55	26.9	0.2	53.7	1.8	53.7	3.6
	Clay (Shell Layer)	--	65 to 85	-55 to -80	1.5	0.2	3.1	1.8	3.1	3.6
13+00	Clay (YBM)	Lower	50 to 60	-41 to -51	2.7	0.2	5.4	1.8	5.4	3.6
		Upper	50 to 60	-41 to -51	3.5	0.2	6.9	1.8	6.9	3.6
14+00	Clay (YBM)	Lower	44 to 54	-41 to -51	2.9	0.2	5.8	1.8	5.8	3.6
		Upper	44 to 54	-41 to -51	3.7	0.2	7.5	1.8	7.5	3.6
	Clay	Lower	54 to 59	-51 to -56	13.3	0.2	26.6	1.8	26.6	3.6
		Upper	54 to 59	-51 to -56	18.4	0.2	36.9	1.8	36.9	3.6

Upper Bound p multiplier 1.5

q-w Curves										
Station	Soil Type	Upper/ Lower	Cumulative Depth Below Mudline (ft)	Elevation (ft)	q1 (kip)	w1 (in)	q2 (kip)	w2 (in)	q2 (kip)	w3 (in)
1+10 to 10+00	Sand	Lower	45 to 55	-35 to -45	149.4	0.4	299.0	2.7	299.0	5.4
		Upper	45 to 55	-35 to -45	156.9	0.4	313.8	2.7	313.8	5.4
	Clay	Lower	55 to 65	-45 to -55	28.8	0.4	57.5	2.7	57.5	5.4
		Upper	55 to 65	-45 to -55	40.3	0.4	80.6	2.7	80.6	5.4
	Clay (Shell Layer)	--	65 to 85	-55 to -80	2.3	0.4	4.6	2.7	4.6	5.4
13+00	Clay (YBM)	Lower	50 to 60	-41 to -51	4.0	0.4	8.1	2.7	8.1	5.4
		Upper	50 to 60	-41 to -51	5.2	0.4	10.4	2.7	10.4	5.4
14+00	Clay (YBM)	Lower	44 to 54	-41 to -51	4.4	0.4	8.7	2.7	8.7	5.4
		Upper	44 to 54	-41 to -51	5.6	0.4	11.2	2.7	11.2	5.4
	Clay	Lower	54 to 59	-51 to -56	20.0	0.4	39.9	2.7	39.9	5.4
		Upper	54 to 59	-51 to -56	27.6	0.4	55.3	2.7	55.3	5.4

Lower Bound p multiplier 0.75

q-w Curves										
Station	Soil Type	Upper/ Lower	Cumulative Depth Below Mudline (ft)	Elevation (ft)	q1 (kip)	w1 (in)	q2 (kip)	w2 (in)	q2 (kip)	w3 (in)
1+10 to 10+00	Sand	Lower	45 to 55	-35 to -45	74.7	0.2	149.5	1.8	149.5	3.6
		Upper	45 to 55	-35 to -45	78.5	0.2	156.9	1.8	156.9	3.6
	Clay	Lower	55 to 65	-45 to -55	14.4	0.2	28.8	1.8	28.8	3.6
		Upper	55 to 65	-45 to -55	20.1	0.2	40.3	1.8	40.3	3.6
	Clay (Shell Layer)	--	65 to 85	-55 to -80	1.2	0.2	2.3	1.8	2.3	3.6
13+00	Clay (YBM)	Lower	50 to 60	-41 to -51	2.0	0.2	4.0	1.8	4.0	3.6
		Upper	50 to 60	-41 to -51	2.6	0.2	5.2	1.8	5.2	3.6
14+00	Clay (YBM)	Lower	44 to 54	-41 to -51	2.2	0.2	4.4	1.8	4.4	3.6
		Upper	44 to 54	-41 to -51	2.8	0.2	5.6	1.8	5.6	3.6
	Clay	Lower	54 to 59	-51 to -56	10.0	0.2	20.0	1.8	20.0	3.6
		Upper	54 to 59	-51 to -56	13.8	0.2	27.6	1.8	27.6	3.6

PROJECT Encinal Terminals
SUBJECT C2 Timber Piles

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

q-w Curves										
Soil Type	Station	Upper/ Lower	Cumulative Depth Below Mudline (ft)	Elevation (ft)	q1 (kip)	w1 (in)	q2 (kip)	w2 (in)	q2 (kip)	w3 (in)
Clay	1+10	Lower	60 to 75	-70 to -85	115.7	0.2	231.4	1.9	231.4	3.8
	1+10	Upper	60 to 75	-70 to -85	118.3	0.2	236.7	1.9	236.7	3.8
	5+10	Lower	60 to 75	-70 to -85	111.5	0.2	223.0	1.9	223.0	3.8
	5+10	Upper	60 to 75	-70 to -85	114.1	0.2	228.3	1.9	228.3	3.8

Upper Bound p multiplier 1.5

q-w Curves										
Soil Type	Station	Upper/ Lower	Cumulative Depth Below Mudline (ft)	Elevation (ft)	q1 (kip)	w1 (in)	q2 (kip)	w2 (in)	q2 (kip)	w3 (in)
Clay	1+10	Lower	60 to 75	-70 to -85	173.6	0.2	347.1	1.9	347.1	3.8
	1+10	Upper	60 to 75	-70 to -85	177.5	0.2	355.1	1.9	355.1	3.8
	5+10	Lower	60 to 75	-70 to -85	167.3	0.2	334.5	1.9	334.5	3.8
	5+10	Upper	60 to 75	-70 to -85	171.2	0.2	342.5	1.9	342.5	3.8

Lower Bound p multiplier 0.75

q-w Curves										
Soil Type	Station	Upper/ Lower	Cumulative Depth Below Mudline (ft)	Elevation (ft)	q1 (kip)	w1 (in)	q2 (kip)	w2 (in)	q2 (kip)	w3 (in)
Clay	1+10	Lower	60 to 75	-70 to -85	86.8	0.2	173.6	1.9	173.6	3.8
	1+10	Upper	60 to 75	-70 to -85	88.7	0.2	177.5	1.9	177.5	3.8
	5+10	Lower	60 to 75	-70 to -85	83.6	0.2	167.3	1.9	167.3	3.8
	5+10	Upper	60 to 75	-70 to -85	85.6	0.2	171.2	1.9	171.2	3.8

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 1+10 Lower Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves

Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	9.0	0.4	0.2	0.4	0.4	0.4	3.6
	2	7.0	0.5	0.2	0.5	0.4	0.5	3.6
	4	5.0	0.6	0.2	0.6	0.4	0.6	3.6
	6	3.0	0.7	0.2	0.6	0.4	0.6	3.6
	8	1.0	0.8	0.2	0.8	0.4	0.8	3.6
	10	-1.0	2.0	0.2	1.8	0.4	1.8	3.6
Clay	12	-3.0	2.4	0.2	2.2	0.4	2.2	3.6
	14	-5.0	2.6	0.2	2.3	0.4	2.3	3.6
	16	-7.0	2.7	0.2	2.4	0.4	2.4	3.6
	18	-9.0	2.8	0.2	2.5	0.4	2.5	3.6
	20	-11.0	3.0	0.2	2.7	0.4	2.7	3.6
	22	-13.0	3.2	0.2	2.9	0.4	2.9	3.6
	24	-15.0	4.0	0.2	3.6	0.4	3.6	3.6
Sand	26	-17.0	5.1	0.1	6.4	0.1	6.4	2.0
	28	-19.0	5.6	0.1	7.0	0.1	7.0	2.0
	30	-21.0	6.1	0.1	7.7	0.1	7.7	2.0
	32	-23.0	6.7	0.1	8.3	0.1	8.3	2.0
	34	-25.0	7.2	0.1	9.0	0.1	9.0	2.0
	36	-27.0	7.7	0.1	9.7	0.1	9.7	2.0
	38	-29.0	8.3	0.1	10.3	0.1	10.3	2.0
	40	-31.0	7.2	0.1	9.0	0.1	9.0	2.0
Clay	42	-33.0	8.6	0.2	7.7	0.4	7.7	0.9
	44	-35.0	9.8	0.2	8.8	0.4	8.8	3.6
Sand	46	-37.0	11.0	0.1	13.7	0.1	13.7	2.0
	48	-39.0	11.5	0.1	14.4	0.1	14.4	2.0
	50	-41.0	13.1	0.1	14.6	0.1	14.6	2.0
	52	-43.0	11.7	0.1	14.6	0.1	14.6	2.0
	54	-45.0	11.7	0.1	14.6	0.1	14.6	2.0
Clay	56	-47.0	14.6	0.2	13.1	0.4	13.1	3.6

PROJECT Encinal Terminals JOB NO. 9769.000.000
SUBJECT C1 Timber Piles MADE BY SOS
STATION 1+10 Upper Bound DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	9.0	0.5	0.2	0.4	0.4	0.4	3.6
	2	7.0	0.6	0.2	0.5	0.4	0.5	3.6
	4	5.0	0.7	0.2	0.6	0.4	0.6	3.6
	6	3.0	0.8	0.2	0.7	0.4	0.7	3.6
	8	1.0	0.9	0.2	0.8	0.4	0.8	3.6
	10	-1.0	2.3	0.2	2.1	0.4	2.1	3.6
Clay	12	-3.0	2.9	0.2	2.6	0.4	2.6	3.6
	14	-5.0	3.0	0.2	2.7	0.4	2.7	3.6
	16	-7.0	3.2	0.2	2.9	0.4	2.9	3.6
	18	-9.0	3.3	0.2	3.0	0.4	3.0	3.6
	20	-11.0	3.4	0.2	3.1	0.4	3.1	3.6
	22	-13.0	3.6	0.2	3.2	0.4	3.2	3.6
	24	-15.0	4.4	0.2	4.0	0.4	4.0	3.6
Sand	26	-17.0	5.5	0.1	6.8	0.1	6.8	2.0
	28	-19.0	6.0	0.1	7.5	0.1	7.5	2.0
	30	-21.0	6.6	0.1	8.3	0.1	8.3	2.0
	32	-23.0	7.2	0.1	9.0	0.1	9.0	2.0
	34	-25.0	7.7	0.1	9.7	0.1	9.7	2.0
	36	-27.0	8.3	0.1	10.4	0.1	10.4	2.0
	38	-29.0	8.9	0.1	11.1	0.1	11.1	2.0
	40	-31.0	8.4	0.1	10.5	0.1	10.5	2.0
Clay	42	-33.0	10.3	0.2	9.3	0.4	9.3	0.9
	44	-35.0	11.5	0.2	10.4	0.4	10.4	3.6
Sand	46	-37.0	12.2	0.1	15.2	0.1	15.2	2.0
	48	-39.0	12.8	0.1	16.0	0.1	16.0	2.0
	50	-41.0	14.6	0.1	16.2	0.1	16.2	2.0
	52	-43.0	13.0	0.1	16.2	0.1	16.2	2.0
	54	-45.0	13.0	0.1	16.2	0.1	16.2	2.0
Clay	56	-47.0	16.2	0.2	14.6	0.4	14.6	3.6

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 5+10 and 10+00 Lower Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	9.0	0.4	0.2	0.4	0.4	0.4	3.6
	2	7.0	0.5	0.2	0.4	0.4	0.4	3.6
	4	5.0	0.6	0.2	0.5	0.4	0.5	3.6
	6	3.0	0.7	0.2	0.6	0.4	0.6	3.6
	8	1.0	0.8	0.2	0.8	0.4	0.8	3.6
	10	-1.0	1.0	0.2	0.9	0.4	0.9	3.6
	12	-3.0	1.1	0.2	1.0	0.4	1.0	3.6
	14	-5.0	1.2	0.2	1.1	0.4	1.1	3.6
	16	-7.0	1.3	0.2	1.2	0.4	1.2	3.6
	18	-9.0	1.4	0.2	1.3	0.4	1.3	3.6
	20	-11.0	2.4	0.2	2.1	0.4	2.1	3.6
Clay	22	-13.0	2.8	0.2	2.5	0.4	2.5	3.6
	24	-15.0	2.9	0.2	2.6	0.4	2.6	3.6
	26	-17.0	3.1	0.2	2.8	0.4	2.8	3.6
	28	-19.0	3.3	0.2	3.0	0.4	3.0	3.6
	30	-21.0	5.5	0.2	4.9	0.4	4.9	3.6
Sand	32	-23.0	5.4	0.1	6.7	0.1	6.7	2.0
	34	-25.0	5.9	0.1	7.4	0.1	7.4	2.0
	36	-27.0	6.4	0.1	8.1	0.1	8.1	2.0
	38	-29.0	7.0	0.1	8.7	0.1	8.7	2.0
	40	-31.0	6.7	0.1	8.4	0.1	8.4	2.0
Clay	42	-33.0	8.2	0.2	7.4	0.4	7.4	0.9
	44	-35.0	9.2	0.2	8.2	0.4	8.2	3.6
Clay	46	-37.0	9.6	0.1	10.8	0.1	12.0	2.0
	48	-39.0	10.1	0.1	12.7	0.1	12.7	2.0
	50	-41.0	12.1	0.1	13.4	0.1	13.4	2.0
	52	-43.0	11.3	0.1	14.1	0.1	14.1	2.0
	54	-45.0	10.7	0.1	13.4	0.1	13.4	2.0
Clay (Shell Layer	56	-47.0	9.4	0.2	8.5	0.5	8.5	3.6

PROJECT Encinal Terminals JOB NO. 9769.000.000
SUBJECT C1 Timber Piles MADE BY SOS
STATION 5+10 and 10+00 Upper Bound DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	9.0	0.5	0.2	0.4	0.4	0.4	3.6
	2	7.0	0.6	0.2	0.5	0.4	0.5	3.6
	4	5.0	0.7	0.2	0.6	0.4	0.6	3.6
	6	3.0	0.8	0.2	0.7	0.4	0.7	3.6
	8	1.0	0.9	0.2	0.8	0.4	0.8	3.6
	10	-1.0	1.0	0.2	0.9	0.4	0.9	3.6
	12	-3.0	1.1	0.2	1.0	0.4	1.0	3.6
	14	-5.0	1.2	0.2	1.1	0.4	1.1	3.6
	16	-7.0	1.4	0.2	1.2	0.4	1.2	3.6
	18	-9.0	1.5	0.2	1.3	0.4	1.3	3.6
	20	-11.0	2.7	0.2	2.5	0.4	2.5	3.6
Clay	22	-13.0	3.3	0.2	2.9	0.4	2.9	3.6
	24	-15.0	3.4	0.2	3.0	0.4	3.0	3.6
	26	-17.0	3.5	0.2	3.1	0.4	3.1	3.6
	28	-19.0	3.7	0.2	3.3	0.4	3.3	3.6
	30	-21.0	5.9	0.2	5.3	0.4	5.3	3.6
Sand	32	-23.0	5.8	0.1	7.2	0.1	7.2	2.0
	34	-25.0	6.4	0.1	8.0	0.1	8.0	2.0
	36	-27.0	6.9	0.1	8.7	0.1	8.7	2.0
	38	-29.0	7.5	0.1	9.4	0.1	9.4	2.0
	40	-31.0	7.8	0.1	9.8	0.1	9.8	2.0
Clay	42	-33.0	9.9	0.2	8.9	0.4	8.9	0.9
	44	-35.0	10.8	0.2	9.7	0.4	9.7	3.6
Sand	46	-37.0	10.7	0.1	13.3	0.1	13.3	2.0
	48	-39.0	11.3	0.1	14.1	0.1	14.1	2.0
	50	-41.0	13.4	0.1	14.9	0.1	14.9	2.0
	52	-43.0	12.6	0.1	15.7	0.1	15.7	2.0
	54	-45.0	12.1	0.1	15.2	0.1	15.2	2.0
Clay (Shell Layer	56	-47.0	11.6	0.2	10.5	0.4	10.5	3.6

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 13+00 Lower Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	9.0	0.0	0.2	0.0	0.4	0.0	3.6
	2	7.0	0.1	0.2	0.1	0.4	0.1	3.6
	4	5.0	0.2	0.2	0.2	0.4	0.2	3.6
	6	3.0	0.3	0.2	0.3	0.4	0.3	3.6
	8	1.0	0.4	0.2	0.4	0.4	0.4	3.6
	10	-1.0	0.5	0.2	0.5	0.4	0.5	3.6
	12	-3.0	0.6	0.2	0.5	0.4	0.5	3.6
	14	-5.0	0.7	0.2	0.6	0.4	0.6	3.6
	16	-7.0	0.8	0.2	0.7	0.4	0.7	3.6
	18	-9.0	0.9	0.2	0.8	0.4	0.8	3.6
	20	-11.0	1.0	0.2	0.9	0.4	0.9	3.6
	22	-13.0	1.1	0.2	1.0	0.4	1.0	3.6
	24	-15.0	1.2	0.2	1.1	0.4	1.1	3.6
	26	-17.0	1.3	0.2	1.2	0.4	1.2	3.6
	28	-19.0	1.4	0.2	1.2	0.4	1.2	3.6
	30	-21.0	1.5	0.2	1.3	0.4	1.3	3.6
	32	-23.0	1.6	0.2	1.4	0.4	1.4	3.6
	34	-25.0	1.7	0.2	1.5	0.4	1.5	3.6
	36	-27.0	1.8	0.2	1.6	0.4	1.6	3.6
	38	-29.0	1.9	0.2	1.7	0.4	1.7	3.6
	40	-31.0	2.0	0.2	1.8	0.4	1.8	3.6
	42	-33.0	2.1	0.2	1.9	0.4	1.9	0.9
	44	-35.0	2.2	0.2	1.9	0.4	1.9	3.6
	46	-37.0	2.3	0.2	2.0	0.4	2.0	3.6
	48	-39.0	2.4	0.2	2.1	0.4	2.1	3.6
	50	-41.0	2.4	0.2	2.1	0.4	2.1	3.6
	52	-43.0	2.4	0.2	2.1	0.4	2.1	3.6
	54	-45.0	2.4	0.2	2.1	0.4	2.1	3.6
	56	-47.0	2.4	0.2	2.1	0.4	2.1	3.6
	58	-49.0	2.4	0.2	2.1	0.4	2.1	3.6
	60	-51.0	2.4	0.2	2.1	0.4	2.1	3.6
Clay	62	-53.0	2.4	0.2	2.1	0.4	2.1	3.6
	64	-55.0	2.4	0.2	2.1	0.4	2.1	3.6
	66	-57.0	2.4	0.2	2.1	0.4	2.1	3.6

PROJECT Encinal Terminals | JOB NO. 9769.000.000
SUBJECT C1 Timber Piles | MADE BY SOS
STATION 13+00 Upper Bound | DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	9.0	0.1	0.2	0.1	0.4	0.1	3.6
	2	7.0	0.2	0.2	0.1	0.4	0.1	3.6
	4	5.0	0.3	0.2	0.2	0.4	0.2	3.6
	6	3.0	0.4	0.2	0.3	0.4	0.3	3.6
	8	1.0	0.5	0.2	0.4	0.4	0.4	3.6
	10	-1.0	0.6	0.2	0.6	0.4	0.6	3.6
	12	-3.0	0.7	0.2	0.7	0.4	0.7	3.6
	14	-5.0	0.8	0.2	0.8	0.4	0.8	3.6
	16	-7.0	1.0	0.2	0.9	0.4	0.9	3.6
	18	-9.0	1.1	0.2	1.0	0.4	1.0	3.6
	20	-11.0	1.2	0.2	1.1	0.4	1.1	3.6
	22	-13.0	1.3	0.2	1.2	0.4	1.2	3.6
	24	-15.0	1.4	0.2	1.3	0.4	1.3	3.6
	26	-17.0	1.5	0.2	1.4	0.4	1.4	3.6
	28	-19.0	1.6	0.2	1.5	0.4	1.5	3.6
	30	-21.0	1.8	0.2	1.6	0.4	1.6	3.6
	32	-23.0	1.9	0.2	1.7	0.4	1.7	3.6
	34	-25.0	2.0	0.2	1.8	0.4	1.8	3.6
	36	-27.0	2.1	0.2	1.9	0.4	1.9	3.6
	38	-29.0	2.2	0.2	2.0	0.4	2.0	3.6
	40	-31.0	2.3	0.2	2.1	0.4	2.1	3.6
	42	-33.0	2.4	0.2	2.2	0.4	2.2	0.9
	44	-35.0	2.6	0.2	2.3	0.4	2.3	3.6
	46	-37.0	2.7	0.2	2.4	0.4	2.4	3.6
	48	-39.0	2.8	0.2	2.5	0.4	2.5	3.6
	50	-41.0	2.8	0.2	2.5	0.4	2.5	3.6
	52	-43.0	2.8	0.2	2.5	0.4	2.5	3.6
	54	-45.0	2.8	0.2	2.5	0.4	2.5	3.6
	56	-47.0	2.8	0.2	2.5	0.4	2.5	3.6
	58	-49.0	2.8	0.2	2.5	0.4	2.5	3.6
	60	-51.0	2.8	0.2	2.5	0.4	2.5	3.6
Clay	62	-53.0	2.8	0.2	2.5	0.4	2.5	3.6
	64	-55.0	2.8	0.2	2.5	0.4	2.5	3.6
	66	-57.0	2.8	0.2	2.5	0.4	2.5	3.6

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 14+00 Lower Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	3.0	0.0	0.2	0.0	0.4	0.0	3.6
	2	1.0	0.1	0.2	0.1	0.4	0.1	3.6
	4	-1.0	0.2	0.2	0.2	0.4	0.2	3.6
	6	-3.0	0.3	0.2	0.3	0.4	0.3	3.6
	8	-5.0	0.4	0.2	0.4	0.4	0.4	3.6
	10	-7.0	0.5	0.2	0.5	0.4	0.5	3.6
	12	-9.0	0.6	0.2	0.6	0.4	0.6	3.6
	14	-11.0	0.7	0.2	0.6	0.4	0.6	3.6
	16	-13.0	0.8	0.2	0.7	0.4	0.7	3.6
	18	-15.0	0.9	0.2	0.8	0.4	0.8	3.6
	20	-17.0	1.0	0.2	0.9	0.4	0.9	3.6
	22	-19.0	1.1	0.2	1.0	0.4	1.0	3.6
	24	-21.0	1.2	0.2	1.1	0.4	1.1	3.6
	26	-23.0	1.3	0.2	1.2	0.4	1.2	3.6
	28	-25.0	1.4	0.2	1.3	0.4	1.3	3.6
	30	-27.0	1.5	0.2	1.4	0.4	1.4	3.6
	32	-29.0	1.6	0.2	1.4	0.4	1.4	3.6
	34	-31.0	1.7	0.2	1.5	0.4	1.5	3.6
	36	-33.0	1.8	0.2	1.6	0.4	1.6	3.6
	38	-35.0	1.9	0.2	1.7	0.4	1.7	3.6
	40	-37.0	2.0	0.2	1.8	0.4	1.8	3.6
	42	-39.0	2.1	0.2	1.9	0.4	1.9	0.9
	44	-41.0	2.2	0.2	2.0	0.4	2.0	3.6
	46	-43.0	2.3	0.2	2.1	0.4	2.1	3.6
	48	-45.0	2.4	0.2	2.2	0.4	2.2	3.6
	50	-47.0	2.4	0.2	2.2	0.4	2.2	3.6
	52	-49.0	2.4	0.2	2.2	0.4	2.2	3.6
	54	-51.0	2.4	0.2	2.2	0.4	2.2	3.6
Clay	56	-53.0	2.4	0.2	2.2	0.4	2.2	3.6
	58	-55.0	2.4	0.2	2.2	0.4	2.2	3.6

PROJECT Encinal Terminals
SUBJECT C1 Timber Piles
STATION 14+00 Upper Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	t1 (psi)	z1 (in)	t2 (psi)	z2 (in)	t3 (psi)	z3 (in)
Clay (YBM)	0	3.0	0.1	0.2	0.1	0.4	0.1	3.6
	2	1.0	0.2	0.2	0.1	0.4	0.1	3.6
	4	-1.0	0.3	0.2	0.3	0.4	0.3	3.6
	6	-3.0	0.4	0.2	0.4	0.4	0.4	3.6
	8	-5.0	0.5	0.2	0.5	0.4	0.5	3.6
	10	-7.0	0.6	0.2	0.6	0.4	0.6	3.6
	12	-9.0	0.8	0.2	0.7	0.4	0.7	3.6
	14	-11.0	0.9	0.2	0.8	0.4	0.8	3.6
	16	-13.0	1.0	0.2	0.9	0.4	0.9	3.6
	18	-15.0	1.1	0.2	1.0	0.4	1.0	3.6
	20	-17.0	1.2	0.2	1.1	0.4	1.1	3.6
	22	-19.0	1.4	0.2	1.2	0.4	1.2	3.6
	24	-21.0	1.5	0.2	1.3	0.4	1.3	3.6
	26	-23.0	1.6	0.2	1.4	0.4	1.4	3.6
	28	-25.0	1.7	0.2	1.6	0.4	1.6	3.6
	30	-27.0	1.8	0.2	1.7	0.4	1.7	3.6
	32	-29.0	2.0	0.2	1.8	0.4	1.8	3.6
	34	-31.0	2.1	0.2	1.9	0.4	1.9	3.6
	36	-33.0	2.2	0.2	2.0	0.4	2.0	3.6
	38	-35.0	2.3	0.2	2.1	0.4	2.1	3.6
	40	-37.0	2.5	0.2	2.2	0.4	2.2	3.6
	42	-39.0	2.6	0.2	2.3	0.4	2.3	0.9
	44	-41.0	2.7	0.2	2.4	0.4	2.4	3.6
	46	-43.0	2.8	0.2	2.5	0.4	2.5	3.6
	48	-45.0	2.9	0.2	2.6	0.4	2.6	3.6
	50	-47.0	3.0	0.2	2.7	0.4	2.7	3.6
	52	-49.0	3.0	0.2	2.7	0.4	2.7	3.6
	54	-51.0	3.0	0.2	2.7	0.4	2.7	3.6
Clay	56	-53.0	3.0	0.2	2.7	0.4	2.7	3.6
	58	-55.0	3.0	0.2	2.7	0.4	2.7	3.6

PROJECT Encinal Terminals
SUBJECT C2 Concrete Piles
STATION 1+10 Lower Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves

Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	T1 (psi)	Z1 (in)	T2 (psi)	Z2 (in)	T3 (psi)	Z3 (in)
Clay	0	-10.0	0.5	0.2	0.4	0.6	0.4	3.8
	2	-12.0	0.6	0.2	0.5	0.6	0.5	3.8
	4	-14.0	0.7	0.2	0.7	0.6	0.7	3.8
Sand	6	-16.0	1.1	0.1	1.3	0.1	1.3	2.0
	8	-18.0	1.6	0.1	2.0	0.1	2.0	2.0
	10	-20.0	2.1	0.1	2.6	0.1	2.6	2.0
	12	-22.0	2.5	0.1	3.2	0.1	3.2	2.0
	14	-24.0	3.0	0.1	3.8	0.1	3.8	2.0
	16	-26.0	3.5	0.1	4.0	0.1	4.4	2.0
	18	-28.0	4.0	0.1	4.5	0.1	5.0	2.0
	20	-30.0	5.4	0.1	6.0	0.1	6.7	2.0
Clay	22	-32.0	7.3	0.2	6.6	0.6	6.6	3.8
	24	-34.0	7.5	0.2	6.7	0.6	6.7	3.8
Sand	26	-36.0	6.4	0.1	8.0	0.1	8.0	2.0
	28	-38.0	6.9	0.1	8.7	0.1	8.7	2.0
	30	-40.0	7.5	0.1	9.4	0.1	9.4	2.0
	32	-42.0	8.1	0.1	9.1	0.1	10.1	2.0
	34	-44.0	8.1	0.1	9.1	0.1	10.1	2.0
Clay	36	-46.0	8.4	0.2	7.6	0.4	7.6	3.8
	38	-48.0	8.5	0.2	7.6	0.4	7.6	3.8
	40	-50.0	8.6	0.2	7.7	0.4	7.7	3.8
	42	-52.0	8.7	0.2	7.9	0.4	7.9	0.9
	44	-54.0	7.0	0.2	6.3	0.4	6.3	3.8
Clay (Shell Layer)	46	-56.0	1.4	0.2	1.3	0.4	1.3	3.8
	48	-58.0	1.4	0.2	1.3	0.4	1.3	3.8
	50	-60.0	1.4	0.2	1.3	0.4	1.3	3.8
	52	-62.0	1.4	0.2	1.3	0.4	1.3	3.8
	54	-64.0	1.4	0.2	1.3	0.4	1.3	3.8
	56	-66.0	1.4	0.2	1.3	0.4	1.3	3.8
	58	-68.0	1.4	0.2	1.3	0.4	1.3	3.8
Clay	60	-70.0	8.6	0.2	7.8	0.4	7.8	3.8
	62	-72.0	11.2	0.2	10.1	0.4	10.1	3.8
	64	-74.0	11.4	0.2	10.2	0.4	10.2	3.8
	66	-76.0	11.6	0.2	10.4	0.4	10.4	3.8
	68	-78.0	11.7	0.2	10.6	0.4	10.6	3.8
	70	-80.0	11.9	0.2	10.7	0.4	10.7	3.8
	72	-82.0	12.1	0.2	10.9	0.6	10.9	3.8
	74	-84.0	12.1	0.2	10.9	0.6	10.9	3.8

PROJECT Encinal Terminals
SUBJECT C2 Concrete Piles
STATION 1+10 Upper Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves

Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	T1 (psi)	Z1 (in)	T2 (psi)	Z2 (in)	T3 (psi)	Z3 (in)
Clay	0	-10.0	0.5	0.2	0.4	0.4	0.4	3.8
	2	-12.0	0.6	0.2	0.5	0.4	0.5	3.8
	4	-14.0	0.8	0.2	0.7	0.4	0.7	3.8
Sand	6	-16.0	1.2	0.1	1.4	0.1	1.4	2.0
	8	-18.0	1.7	0.1	2.1	0.1	2.1	2.0
	10	-20.0	2.2	0.1	2.8	0.1	2.8	2.0
	12	-22.0	2.7	0.1	3.4	0.1	3.4	2.0
	14	-24.0	3.3	0.1	4.1	0.1	4.1	2.0
	16	-26.0	3.8	0.1	4.7	0.1	4.7	2.0
	18	-28.0	4.3	0.1	5.4	0.1	5.4	2.0
	20	-30.0	6.3	0.1	7.9	0.1	7.9	2.0
Clay	22	-32.0	8.8	0.2	7.9	0.4	7.9	3.8
	24	-34.0	8.9	0.2	8.0	0.4	8.0	3.8
Sand	26	-36.0	7.1	0.1	8.9	0.1	8.9	2.0
	28	-38.0	7.7	0.1	9.7	0.1	9.7	2.0
	30	-40.0	8.4	0.1	10.5	0.1	10.5	2.0
	32	-42.0	9.0	0.1	11.2	0.1	11.2	2.0
	34	-44.0	9.3	0.1	11.6	0.1	11.6	2.0
Clay	36	-46.0	10.8	0.2	9.7	0.4	9.7	3.8
	38	-48.0	10.9	0.2	9.8	0.4	9.8	3.8
	40	-50.0	11.1	0.2	10.0	0.4	10.0	3.8
	42	-52.0	11.2	0.2	10.1	0.4	10.1	0.9
	44	-54.0	8.8	0.2	7.9	0.4	7.9	3.8
Clay (Shell Layer)	46	-56.0	1.4	0.2	1.3	0.4	1.3	3.8
	48	-58.0	1.4	0.2	1.3	0.4	1.3	3.8
	50	-60.0	1.4	0.2	1.3	0.4	1.3	3.8
	52	-62.0	1.4	0.2	1.3	0.4	1.3	3.8
	54	-64.0	1.4	0.2	1.3	0.4	1.3	3.8
	56	-66.0	1.4	0.2	1.3	0.4	1.3	3.8
	58	-68.0	1.4	0.2	1.3	0.4	1.3	3.8
Clay	60	-70.0	10.3	0.2	9.3	0.4	9.3	3.8
	62	-72.0	13.4	0.2	12.1	0.4	12.1	3.8
	64	-74.0	13.5	0.2	12.2	0.4	12.2	3.8
	66	-76.0	13.6	0.2	12.3	0.4	12.3	3.8
	68	-78.0	13.7	0.2	12.4	0.4	12.4	3.8
	70	-80.0	13.8	0.2	12.4	0.4	12.4	3.8
	72	-82.0	14.0	0.2	12.6	0.4	12.6	3.8
	74	-84.0	14.0	0.2	12.6	0.4	12.6	3.8

PROJECT Encinal Terminals
SUBJECT C2 Concrete Piles
STATION 5+10 Lower Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves								
Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	T1 (psi)	Z1 (in)	T2 (psi)	Z2 (in)	T3 (psi)	Z3 (in)
Clay	0	-10.0	0.5	0.2	0.4	0.4	0.4	3.8
	2	-12.0	0.6	0.2	0.5	0.4	0.5	3.8
	4	-14.0	0.6	0.2	0.6	0.4	0.6	3.8
	6	-16.0	0.7	0.2	0.6	0.4	0.6	3.8
	8	-18.0	0.8	0.2	0.7	0.4	0.7	3.8
	10	-20.0	1.6	0.2	1.5	0.4	1.5	3.8
Sand	12	-22.0	1.9	0.1	2.4	0.1	2.4	2.0
	14	-24.0	2.4	0.1	3.0	0.1	3.0	2.0
	16	-26.0	2.9	0.1	3.6	0.1	3.6	2.0
	18	-28.0	3.4	0.1	4.2	0.1	4.2	2.0
	20	-30.0	5.1	0.1	6.3	0.1	6.3	2.0
Clay	22	-32.0	7.1	0.2	6.4	0.4	6.4	3.8
	24	-34.0	7.1	0.2	6.4	0.4	6.4	3.8
Sand	26	-36.0	5.7	0.1	7.1	0.1	7.1	2.0
	28	-38.0	6.2	0.1	7.8	0.1	7.8	2.0
	30	-40.0	6.8	0.1	8.5	0.1	8.5	2.0
	32	-42.0	7.4	0.1	9.2	0.1	9.2	2.0
	34	-44.0	7.5	0.1	9.4	0.1	9.4	2.0
Clay	36	-46.0	8.2	0.2	7.4	0.4	7.4	3.8
	38	-48.0	8.3	0.2	7.5	0.4	7.5	3.8
	40	-50.0	8.5	0.2	7.6	0.4	7.6	3.8
	42	-52.0	8.6	0.2	7.7	0.4	7.7	0.9
	44	-54.0	6.8	0.2	6.1	0.4	6.1	3.8
Clay (Shell Layer)	46	-56.0	1.4	0.2	1.3	0.4	1.3	3.8
	48	-58.0	1.4	0.2	1.3	0.4	1.3	3.8
	50	-60.0	1.4	0.2	1.3	0.4	1.3	3.8
	52	-62.0	1.4	0.2	1.3	0.4	1.3	3.8
	54	-64.0	1.4	0.2	1.3	0.4	1.3	3.8
	56	-66.0	1.4	0.2	1.3	0.4	1.3	3.8
	58	-68.0	1.4	0.2	1.3	0.4	1.3	3.8
Clay	60	-70.0	8.4	0.2	7.6	0.4	7.6	3.8
	62	-72.0	10.9	0.2	9.8	0.4	9.8	3.8
	64	-74.0	11.1	0.2	10.0	0.4	10.0	3.8
	66	-76.0	11.3	0.2	10.2	0.4	10.2	3.8
	68	-78.0	11.5	0.2	10.3	0.4	10.3	3.8
	70	-80.0	11.7	0.2	10.5	0.4	10.5	3.8
	72	-82.0	11.8	0.2	10.7	0.4	10.7	3.8
	74	-84.0	11.9	0.2	10.7	0.4	10.7	3.8

PROJECT Encinal Terminals
SUBJECT C2 Concrete Piles
STATION 5+10 Upper Bound

JOB NO. 9769.000.000
MADE BY SOS
DATE 10/2/17

t-z Curves

Soil Type	Cumulative Depth Below Mudline (ft)	Elevation (ft)	T1 (psi)	Z1 (in)	T2 (psi)	Z2 (in)	T3 (psi)	Z3 (in)
Clay	0	-10.0	0.5	0.2	0.4	0.4	0.4	3.8
	2	-12.0	0.6	0.2	0.5	0.4	0.5	3.8
	4	-14.0	0.6	0.2	0.6	0.4	0.6	3.8
	6	-16.0	0.7	0.2	0.6	0.4	0.6	3.8
	8	-18.0	0.8	0.2	0.7	0.4	0.7	3.8
	10	-20.0	1.7	0.2	1.5	0.4	1.5	3.8
Sand	12	-22.0	2.0	0.1	2.6	0.1	2.6	2.0
	14	-24.0	2.6	0.1	3.2	0.1	3.2	2.0
	16	-26.0	3.1	0.1	3.9	0.1	3.9	2.0
	18	-28.0	3.6	0.1	4.5	0.1	4.5	2.0
	20	-30.0	6.0	0.1	7.5	0.1	7.5	2.0
Clay	22	-32.0	8.5	0.2	7.7	0.4	7.7	3.8
	24	-34.0	8.4	0.2	7.6	0.4	7.6	3.8
Sand	26	-36.0	6.3	0.1	7.9	0.1	7.9	2.0
	28	-38.0	7.0	0.1	8.7	0.1	8.7	2.0
	30	-40.0	7.6	0.1	9.5	0.1	9.5	2.0
	32	-42.0	8.2	0.1	10.3	0.1	10.3	2.0
	34	-44.0	8.7	0.1	10.8	0.1	10.8	2.0
Clay	36	-46.0	10.6	0.2	9.5	0.4	9.5	3.8
	38	-48.0	10.7	0.2	9.7	0.4	9.7	3.8
	40	-50.0	10.9	0.2	9.8	0.4	9.8	3.8
	42	-52.0	11.0	0.2	9.9	0.4	9.9	0.9
	44	-54.0	8.7	0.2	7.8	0.4	7.8	3.8
Clay (Shell Layer)	46	-56.0	1.4	0.2	1.3	0.4	1.3	3.8
	48	-58.0	1.4	0.2	1.3	0.4	1.3	3.8
	50	-60.0	1.4	0.2	1.3	0.4	1.3	3.8
	52	-62.0	1.4	0.2	1.3	0.4	1.3	3.8
	54	-64.0	1.4	0.2	1.3	0.4	1.3	3.8
	56	-66.0	1.4	0.2	1.3	0.4	1.3	3.8
	58	-68.0	1.4	0.2	1.3	0.4	1.3	3.8
Clay	60	-70.0	10.2	0.2	9.2	0.4	9.2	3.8
	62	-72.0	13.2	0.2	11.9	0.4	11.9	3.8
	64	-74.0	13.4	0.2	12.0	0.4	12.0	3.8
	66	-76.0	13.5	0.2	12.1	0.4	12.1	3.8
	68	-78.0	13.6	0.2	12.2	0.4	12.2	3.8
	70	-80.0	13.7	0.2	12.3	0.4	12.3	3.8
	72	-82.0	13.8	0.2	12.4	0.4	12.4	3.8
	74	-84.0	13.8	0.2	12.4	0.4	12.4	3.8